Utah Science Vol. 27 No. 1, March 1966

UTAH SCIENCE

MARCH 1966
Volume 27
Number 1

AGRICULTURAL EXPERIMENT STATION • UTAH STATE UNIVERSITY • LOGAN

Utah is an arid region and its people depend on the life-giving moisture of these high-bedded snow fields.

When the pioneers entered these valleys, one of the first things they did was to channel the streams out over the land, soak the soil, plow, plant, and cultivate their crops. Their very existence depended on how well they utilized these waters. As the years passed, thousands came to populate the valleys. To solve the problems of living in these arid lands, new irrigation techniques were developed, dry lands were farmed, stock was turned out on the rangelands, the cities flourished, and industry, mining, then manufacturing, came.

Utah along with the rest of the Nation, boomed during and after World War II. Her growth has mushroomed. Her million-plus inhabitants are striving for the "good things of life." Continuing progress demands that new industry be brought into the State. Farmers need more arable acres, as residential districts infringe on present agricultural lands. More and better crops are needed. More schools, more roads, more and better public facilities are needed. These, and myriad other problems are all directly related to those snowbanks high in the hills. They are our prime source of water, and without water we perish.

To effectively utilize water, we need to know how much is available. Just how much rain and snow fall on Utah? How much of it is evaporated; how much is lost into the ground; how much flows into our streams? We must find the answers to these questions before we can efficiently plan for effective water use.

A start has been made. Read about it in this issue of Utah Science.

CONTENTS

UTAH FARM AND HOME SCIENCE

A quarterly devoted to research in agriculture, land and water resources, home and community life, human nutrition and development, and published by the Agricultural Experiment Station, Utah State University of Agriculture and Applied Sciences, Logan, Utah 84321.

The magazine will be sent free on request.

To avoid overuse of technical terms, trade names of products or equipment sometimes are used. No endorsement of specific products or firms named is intended, nor is criticism implied of those not mentioned.

Articles and information appearing in Utah Farm and Home Science become public property upon publication. They may be reprinted provided that no endorsement of a specific commercial product or firm is stated or implied in so doing.

Please credit the authors, Utah State University, and Utah Farm and Home Science.

Greens FOR Houses

BERNARD G. WESENBERG

Growing plants for pleasure, indoors or out, appeals to just about everyone. For most people it is a challenge to grow a plant well. Successes on certain ventures lead to other challenges which exist in tremendous variety. The appreciation of living decorative plants is actually universal.

Application of scientific knowledge has helped create a boom in indoor plant use and the architectural incorporation of expenses of glass has promoted the growing of such plants.

HOUSES ARE DRY

When a plant is invited to a spot in one's living room, how suitable is the environment provided? Indoor conditions are chosen to suit the human inhabitants, so the temperature is uniformly somewhere near 70° F. Central heating without mechanical humidification results in extremely low relative humidity. In addition, the wall areas and draperies lower the light intensity severely. From the new house plant's point of view, its corner could be described as a HOT, DRY, AND UNBEARABLY DARK DESERT.

It, if it had a choice, would much prefer a greenhouse as a home. In a greenhouse much greater light intensity is available. Night temperatures are kept at 60 to 65° F for most plants; some as low as 50° F. Higher relative humidity is a third benefit to greenhouse plants.

Some people can afford to provide their plants with a greenhouse environment. Such hobby greenhouses may be small copies of the commercial types, or they may be structures attached to the home, or simply window-size units.

•

BERNARD G. WESENBERG is an assistant professor of horticulture in the Department of Plant Science.

HOUSES LACK LIGHT

The usual situation, however, is to bring a few plants into our homes where they must tolerate the people-oriented environment. Scientific consideration has shown that the natural environment most nearly resembling our semi-dark, 70° F rooms is the floor of tropical forests. Only a small amount of light penetrates the dense tropical jungle and the temperatures of this forest floor are similar to the thermostat settings in most homes. The one glaring difference in comparing our home interiors to the jungle floor is the lack of humidity. "The steaming jungle" is completely foreign to the desert-like atmosphere inside our homes.

In spite of this one lack, the plants commonly used as indoor plants are immigrants from tropical areas. African voilets and the varied philodendrons are excellent examples of home-tolerant plants taken from tropical environments.

If we wish to enjoy the challenge of growing decorative plants in our homes we should realize the limitations of not providing greenhouse surroundings. Indoor plants must be chosen which are tolerant to the environment in the home. Soil and water needs can be managed easily once they are understood. The light and temperature in the home can not readily be adjusted for the plant's benefit so they are most critical aspects. Knowing the light and temperature requirements of the plants you wish to grow is the first step. For example, cyclamen which need a 50 to 55° F night temperature did well in the cool, well-lighted sunporches or the windows in the unheated bedrooms of Grandma's day. Growing cyclamen in the present-day living room is futile, however, because the temperatures are too high. The display is wonderful but the cyclamen plant does not last long enough to display the flowering potential it would produce at lower temperatures.

LIGHT REQUIREMENTS

Light requirements have two dimensions. One is intensity and the other is duration. African violets illustrate light intensity requirements. They will flower only if the light intensity is between 500 and 1,300 footcandles. This is a fairly low light requirement when compared to a normal sunny day which will range near 10,000 footcandles. Yet this is a high requirement when compared to general home interior which averages 5 foot candles with normal lamp usage. Indoor areas we consider well lighted for reading range from 20 to 50 footcandles. Thus the north or east window exposure is necessary to provide an African Violet with proper light intensity.

The duration of light means the length of day, which is also termed "photoperiod." In commercial production the flowering of chrysanthemum and poinsettia is regulated by controlling the number of hours of light. This is done by covering the plants with black shade cloth to keep out the light. A poinsettia grown in the home must be shaded or put in a closet each evening as the light from a table lamp is sufficient to keep it from flowering. None of the commercial flowering plants are adapted to growing inside our homes. With special treatments and care some can be flowered in the home but it is difficult to get the quality which results from greenhouse culture.

PROPER CARE

The foliage plants are more closely suited to our indoor surroundings. Provide a position with as much light as possible, however. If a foliage plant is placed in a dark location for a couple of weeks, shift it nearer to a window again so that it can recover. Artificial lights benefit plants but the light source should be near the plant. To promote the plant's welfare the length of exposure should be about 16 hours per day.

Most indoor plants are on display and the culture given them should be aimed at keeping them in good condition — not at getting rapid growth. Water sparingly, but when water is needed apply enough to wet the entire soil ball. Infrequent, adequate watering is much more beneficial than a daily dribble which wets only the top half-inch.

Fertilizer should be used with restraint. Occasional repotting with a good soil mix may be even better than using fertilizers. The mixture used for foliage plants should be porous enough to guarantee good dainage and aeration. Peat moss, sand, and soil in equal parts is a good, general mixture to use.

These minimal water and fertilizer levels are recommended because the overall house plant environment then will be more nearly balanced. Higher water and fertilizer levels would promote growth but light and temperature conditions are not suitable for quality growth. Thus, plants look best for the longest time if all factors are regulated to keep growth at a minimum. When specimens become unsatisfactory, the most likely causes of trouble are overwatering, overfertilization, or too low levels of light intensity.

Figure 1. Grape ivy (Cissus rhombifolia), on the table, is one of the plants most adaptable to the desert-like conditions in the modern American home.

GREENHOUSES

This awareness of the shortcomings of a home interior for plant culture may help you understand the advantages to a specialized structure. Hobby greenhouses may be as small as a window unit, which resembles a bay window but has facilities for temperature control. Aluminum and glass models to fit standard windows begin at $75.00. The most economical walk-in size is a lean-to greenhouse which may also have the appeal of direct access from within the home. A lean-to uses one wall of the house or garage as one side. A free-standing greenhouse, or minature commercial house, is another possibility. Examples of cost for such structures are $470.00 for a 10 x 14-foot all-aluminum lean-to, and $845.00 for a 14 x 16-foot freestanding building.[1]

These expenses are comparable to many other interests for enjoyment, such as a motor and boat or camping facilities, on which a person or family may decide to spend money. The home greenhouse offers, even demands, much more interest and use than certain other kinds of equipment.

Covering greenhouses with plastic is commonly used for commercial purposes because of its economy. For a hobby or home greenhouse, lightweight plastic film is not recom-

[1]Inquire of the author if you wish names of dealers.

mended. Rigid plastic or fiberglass, however, may be very suitable. A permanent glass house is the most appealing in appearance and the best general consideration.

The basic operations which must be provided in operating a greenhouse are temperature control, watering, soil and fertilizer management, and pest control.

GREENHOUSE MANAGEMENT

Temperature control for small units is handled by automatic devices. A minimum temperature is selected and heat is turned on by the thermostat, just as in the home. Ventilation to prevent excessive temperature buildup or unnecessary loss of heat also is controlled by sensing units. A 10° F to 15° F span is the normal temperature range greenhouse controls are set to maintain. When the upper temperature of the desired range is reached due to the sun's heat, a row of glass panels attached to the peak of the greenhouse is opened so warm air may escape. Unless cooling devices are provided, temperature may rise beyond the upper limit even after maximum ventilation. Summer control of temperature may be difficult because of the heat produced by bright sunshine. Shading compounds are applied by commercial growers. This may be considered unsightly for home greenhouses so slat shading may be used. Evaporative coolers are the most suitable system if mechanical cooling is desired.

Watering is a routine chore but it is also the best time for the grower to observe plant progress and development. During warm seasons the floors and walkways are also wetted down regularly to increase the humidity. Regular and thorough observation to police pest invasions is necessary. Prevention is most desirable but infestations can be eliminated with correct use and timing of sprays.

Good soil management depends entirely upon using materials such as peat moss or perlite in the mixture so that proper drainage is provided. Sand also promotes drainage but it lacks the water-holding capacity of either perlite or organic material like peat moss. Ordinary soil provides a reservoir of mineral elements which are needed along with the fertilizer used.

(Continued on page 44)

Figure 2. The rubber plant (Ficus elastica), left end, and the fiddle leaf fig (Ficus pandurata), tall branched plant on right end, dominate this large scale planter box to form a very appealing display.

Figure 3. This custom greenhouse has glass on only the roof and the south wall, yet proves adequate for growing a wide range of decorative plants. It is a marvelous piece of hobby equipment.

WHO PAYS THE TAX BILL?

RONDO A. CHRISTENSEN

The past decade has been marked with a tremendous increase in the amount and type of services provided by state and local governments in Utah. To finance them, taxes have also spiraled upward. Combined state and local tax collections have more than doubled since 1955 and amounted to an estimated high of $275 million in 1965. This is about $275 for each man, woman and child in the state.

Where did the money come from? Who paid it? Is the tax burden distributed equitably among the population? These are legitimate questions and are of great concern to those who must foot the tax bill. Undoubtedly, our tax structure does not affect everyone the same way. Individual tax burdens vary with the taxes that are levied and the rates at which they are applied.

This article has to do with how Utahns shared in the tax bill for 1963. It attempts to cast some objective light on the relative tax burden carried by different income and occupational groups. Tax burden is measured in terms of taxes paid as a percent of income before taxes.

1963 TAX COLLECTIONS

Utah's total tax collections in 1963 amounted to $225.4 million (table 1). Numerous taxes were levied by the state and local governments to raise this money. The property tax overshadowed all others and accounted for 47 percent of total collections. The general sales tax was the second most important source of tax income and contributed 22 percent; selective sales taxes added 13 percent. Individual income taxes, another important source, contributed 9 percent. Motor vehicle licenses amounted to 3 percent. The balance was made up of other miscellaneous taxes.

●

RONDO A. CHRISTENSEN is an associate professor in the Department of Agricultural Economics.

TAXES ANALYZED

The incidence of real and property taxes, general sales taxes, Utah income taxes, and vehicle licenses is analyzed in this report. The first three taxes are levied to provide general public services and make up a majority of Utah's tax collections. Vehicle licenses were included because they were conglomerated with property taxes.

The analysis is based on a sample of 5,810 individual itemized income tax returns filed for 1963 by Utah residents. This was about a 3 percent sample of all individual itemized returns. Each return was assumed to represent a family unit. Included in the study were all property, general sales, income, and vehicle license taxes itemized as deductions by individuals, or paid by them in the operation of a farm or self-employed business.

To facilitate the analysis all families were divided into three income groups according to net income from all sources before taxes: less than $4,000, $4,000 to $8,000, and more than $8,000. They were also classified into nine occupational groups according to the nature of their employment or major source of income. Families were classified as self-employed or farmers if gross income from these sources exceeded income from wages and salaries.

One can safely generalize from the data presented in this article to all residents itemizing deductions, but not to all families in the state, since a greater proportion of the higher income families itemize deductions.

LOWER INCOME FAMILIES

The average net income of lower income family units was $2,392; it ranged from a low of $1,964 for retired families to a high of $2,904 for farmers (table 2). Taxes paid per family averaged $157 and varied from a low of $106 for unskilled workers to a high of $538 for farmers.

Taxes paid per family unit varied much more than income. The combined tax paid by farmers in percent of income was almost three times as large as for all family units in the lower income group — 18.1 and 6.6 percent of their income, respectively. The self-employed paid 10.4 percent and retired people paid 10.2 percent. All other occupational groups paid taxes equivalent to about 5 to 6 percent of their income. As will be seen later, the relatively large tax burden carried by farmers and self-employed families is due mainly to large property taxes, and partially to larger than average sales taxes. Retired families in this particular group had high taxes because of larger than average property taxes.

Table 1. 1963 Utah tax collections

Source	Million dollars	Percent
Property taxes	106.8	47
General sales taxes	48.8	22
Selective sales taxes	28.9	13
Individual income tax	20.7	9
Motor vehicle licenses	5.9	3
Other taxes	14.3	6
Total	225.4	100

Source: Seventeenth Biennial Report of the Utah State Tax Commission.
Note: Property taxes are for calendar year 1963; all other taxes are for fiscal year ending June 30, 1963.

Table 2. Incidence of Utah taxes on lower income families, 1963 (Under $4000)

Occupation	Number of families	Income per family	Tax per family	Tax in percent of income
Self-employed	61	$2,866	$297	10.4
Professional, salaried	139	2,496	146	5.8
Sales, clerical	426	2,506	115	4.6
Skilled workers	60	2,605	147	5.6
Semi-skilled workers	181	2,519	140	5.6
Unskilled workers	355	2,098	106	5.1
Farmers	77	2,904	538	18.1
Retired	113	1,964	199	10.2
Other	89	2,234	136	6.1
Total	1,501	2,392	157	6.6

Table 3. Incidence of Utah taxes on middle income families, 1963 ($4,000 to $8,000)

Occupation	Number of families	Income per family	Tax per family	Tax in percent of income
Self-employed	120	$6,044	$535	8.9
Professional, salaried	598	6,323	354	5.6
Sales, clerical	559	5,762	326	5.7
Skilled workers	516	6,317	361	5.7
Semi-skilled workers	711	6,207	361	5.8
Unskilled workers	292	5,625	615	10.9
Farmers	64	6,808	1,199	17.6
Retired	22	5,629	370	6.6
Other	99	5,987	326	5.4
Total	2,981	6,104	402	6.6

Table 4. Incidence of Utah taxes on upper income families, 1963 (Over $8,000)

Occupation	Number of families	Income per family	Tax per family	Tax in percent of income
Self-employed	93	$20,214	$1,661	8.2
Professional, salaried	544	12,053	712	5.9
Sales, clerical	184	11,140	689	6.2
Skilled workers	165	10,374	624	6.0
Semi-skilled workers	218	9,700	559	5.8
Unskilled workers	41	10,631	617	5.8
Farmers	18	13,764	1,964	14.3
Retired	8	16,087	864	5.4
Other	57	12,453	752	6.0
Total	1,328	11,924	756	6.3

Table 5. Incidence of retail sales taxes in Utah, 1963

	Lower income		Middle income		Upper income	
Occupation	Tax per family	Percent of income	Tax per family	Percent of income	Tax per family	Percent of income
Self-employed	$106	3.7	$146	2.4	$411	2.0
Professional, salaried	66	2.6	139	2.2	222	1.8
Sales, clerical	56	2.2	125	2.2	212	1.9
Skilled workers	63	2.4	141	2.2	207	2.0
Semi-skilled workers	63	2.5	156	2.5	195	2.0
Unskilled workers	53	2.5	171	3.0	207	1.9
Farmers	118	4.1	229	3.4	481	3.5
Retired	50	2.5	112	2.0	238	1.5
Other	49	2.2	122	2.0	222	1.8
Total	62	2.6	145	2.4	231	1.9

HIGHER INCOME FAMILIES

Tables 3 and 4 give the combined tax incidence for middle and upper income categories. Middle income families averaged $6,104 income and paid $402 in taxes; upper income families had average incomes of $11,924 and taxes of $756.

As with the lower income group, farmers in the middle and upper income categories bear tax burdens considerably heavier than other occupational groups.

Farmers in the middle income category paid taxes equal to 17.6 percent of income; in the upper income category they paid 14.3 percent.

Self-employed persons also pay consistantly higher taxes than most people. Their taxes average about half again as much as most groups. Unskilled workers in the middle income group paid 10.9 percent of their income in taxes. This was unusually high. The extra taxes were due entirely, however, to taxes paid on farm property. Many people in this category had farming operations but were classified as unskilled workers because their income from salaries and wages exceeded gross income from farming.

Unskilled workers in the upper income group as well as professional, salaried, sales, clerical, skilled, semi-skilled, retired and other workers in both income groups, all had tax burdens equal to about 6 percent of net income. "Other" workers included those whose occupations were unknown.

The average income of all families in the sample was $6,475. Of this $419 per family, or 6.5 percent of income was paid for Utah sales, property, income, and vehicle license taxes. Combining all three income groups, farmers paid the most taxes per family, both in total dollars as well as in percent of income. Their tax bill in 1963 averaged $966 or 17 percent of income. Self-employed persons also paid a large tax per family, $864, but their income was substantially more than average while income of farmers was less than average.

Table 6. Incidence of Property taxes in Utah, 1963[1]

Occupation	Lower income: Tax per family	Lower income: Percent of income	Middle income: Tax per family	Middle income: Percent of income	Upper income: Tax per family	Upper income: Percent of income
Self-employed	$187	6.5	$357	5.9	$836	4.1
Professional, salaried	58	2.3	164	2.6	306	2.5
Sales, clerical	44	1.8	155	2.7	299	2.7
Skilled workers	72	2.8	171	2.7	291	2.8
Semi-skilled workers	65	2.6	164	2.6	243	2.5
Unskilled workers	43	2.0	404	7.2	258	2.4
Farmers	415	14.3	940	13.8	1,274	9.3
Retired	143	7.3	197	3.5	187	1.2
Other	78	3.5	151	2.5	326	2.6
Total	83	3.5	211	3.5	342	2.9

[1]Includes vehicle licenses.

Table 7. Incidence of income taxes in Utah, 1963

Occupation	Lower income: Tax per family	Lower income: Percent of income	Middle income: Tax per family	Middle income: Percent of income	Upper income: Tax per family	Upper income: Percent of income
Self-employed	$ 5	.2	$32	.5	$412	2.0
Professional, salaried	22	.9	52	.8	183	1.5
Sales, clerical	15	.6	46	.8	178	1.6
Skilled workers	12	.5	49	.8	126	1.2
Semi-skilled workers	11	.4	41	.7	121	1.4
Unskilled workers	9	.4	40	.7	151	1.4
Farmers	6	.2	30	.4	210	1.5
Retired	6	.3	60	1.1	439	2.7
Other	10	.4	54	.9	204	1.6
Total	12	.5	45	.7	183	1.5

GENERAL SALES TAX

The incidence of the general sales tax is shown separately by income and occupational groups. Lower income families reported an average of $62 sales taxes compared with $145 for middle income families and $231 for upper income families (table 5). Sales taxes paid increased with income. However, in relation to income, the sales tax was regressive. That is, the lower the income per family the higher the percent of income paid for sales taxes. Sales taxes amounted to 2.6 percent of income for the lower income group compared with 2.4 percent for the middle income group and 1.9 percent for the upper group.

Farmers paid the most sales tax, both in dollars and in percent of income. In general, self-employed were next highest. Taxpayers in these two groups pay sales taxes like all other people on family purchases such as food and clothing. In addition, they must pay sales taxes on certain purchases of supplies, services and equipment for their businesses and farming operations.

The combined state and local sales tax levy in 1963 was 3.0 percent during the first half year, and 3.5 percent during the latter half.

PROPERTY TAX

For most families, the property tax bit hardest. Lower income families paid an average of $83 compared with $211 for middle income families and $342 for upper income families (table 6). While upper income families paid the most property taxes, in percent of income their burden was the smallest — 2.9 percent compared with 3.5 percent for the other two groups.

Again, the same two occupational groups stood out in terms of the tax incidence they bear — farmers and self-employed. Regardless of whether one looks at total dollar tax payments or taxes paid as a percent of income, their taxes are high. Farmers in the low income group paid an average of $415 or 14.3 percent of their income in property taxes. This was about four times the group average. Self-employed people paid $187 or 6.5 percent of their income. This was about twice the average. Property taxes for most others in the lower income group amounted to 1 to 2 percent of income. Retired families were an exception. They apparently had larger than average property holdings like farmers and the self-employed.

Middle and upper income families had property tax incidence patterns similar to the lower income group, with farmers and self-employed carrying the largest burdens. Unskilled workers in the middle income group also had a heavier than average burden, but as was explained before, this was entirely due to the extra taxes paid on their farming operations.

INCOME TAX

The Utah income tax, compared with sales and property taxes, was the least important as a source of revenue. The lower income group paid only $12 per family. The middle income group paid $45 and the upper income group paid $183 per family (table 7). In percent of income, income taxes ranged between a low of 0.2 to a high of 2.7 among all income and occupational groups.

The income tax was progressive with the higher income families not only paying a larger tax in dollars, but also in percent of their incomes. Lower income families paid an average of 0.5 percent of income in income taxes compared with 0.7 percent for middle income families and 1.5 percent for the upper income families.

The incidence of income taxes by occupation varied among the three income groups. Professional and salaried people carried the heaviest burden in the lower income group while retired families had the heaviest burden in the other two groups. Farmers tended to be among those with the lighter burdens.

The preceding tables indicate that most of the disproportionality of total taxes paid by Utahns results

(Continued on page 17)

Herbicide control of rabbitbrush and sagebrush in mixed stands

C. WAYNE COOK

Research has shown that both sagebrush and rabbitbrush species compete seriously with range forage plants. Sagebrush and rabbitbrush frequently occur together as invading species on deteriorated range lands.

The use of herbicides for controlling sagebrush and rabbitbrush in rehabilitating range lands shows great promise. Until recently, recommended practices for the control of these species were unsound because of limited research information. During the past 3 years the Department of Range Science at the Utah State University carried out a study dealing with the control of sagebrush and rabbitbrush infestations on native and seeded ranges by selective herbicides. The main objective of the study was to find a herbicide that would kill both sagebrush and rabbitbrush in one application.

HERBICIDES

Herbicides were applied to mixed stands of big sagebrush and little rabbitbrush *(Chrysothamnus viscidiflorus)* at Randolph and Eureka, Utah, and to mixtures of big sagebrush and big rabbitbrush *(Chrysothamnus Nauseosus)* at Vernon and Bluffdale, Utah.

During a 3-year period 1963-65, a relatively new herbicide called Tordon 22-K was used on mixed stands of sagebrush and rabbitbrush species. Tordon 22-K was applied along with Kuron and Esteron at all four experimental areas during the first week in June 1963. Kills of sagebrush and rabbitbrush showed differential response among the three herbicides in 1963. Hence, various mixtures of the three were tried in 1964 and 1965.

Kuron and Esteron 76-E are esters of 2,4,5-T and 2,4-D respectively. These were applied alone at 3 pounds of active acid per acre. Tordon 22-K is effective at the lower rates. Therefore, it was applied at only 1 pound per acre. The mixtures consisted of 1/3 pound of active acid of Tordon 22-K and 1 1/3 pounds of active acid of either Kuron or Esteron 76-E. Tordon 101, a commercial mixture of Tordon 22-K (5.7%) and 2,4-D as a salt (21.2%), was applied at 1 1/2 pounds of acid equivalent per acre.

These herbicides were applied during the first week in June during all 3 years. Other studies show the first week in June as usually being most suitable for killing mixed sagebrush and rabbitbrush. This assumes that soil moisture is available and maximum day-time temperatures approach 70° F. Percent kill of plants treated in the spring was determined the following spring except for the spring applications of 1965. The percent kill of brush on these areas was determined in the autumn (September 20-21), 1965.

KILLS

Applications of the esters of 2,4-D and 2,4,5-T, (Esteron and Kuron) caused excellent kills of sagebrush in all cases but generally poor kills of the rabbitbrush species resulted. Application of Tordon 22-K or Tordon 101 gave excellent kills of both little and big rabbitbrush but poor kills of big sagebrush (table 1).

All applications of mixtures of the

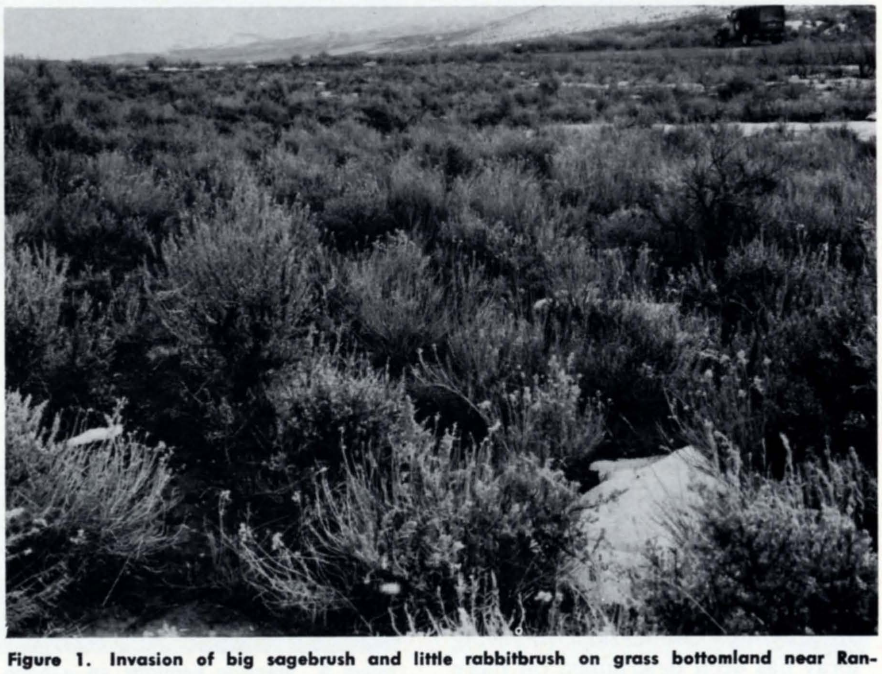

Figure 1. Invasion of big sagebrush and little rabbitbrush on grass bottomland near Randolph, Utah.

C. WAYNE COOK is the assistant dean and professor in the College of Natural Resources.

Table 1. Average percent plants killed after application of various herbicides during the first week in June at four locations where mixtures of sagebrush and rabbitbrush were present

Herbicide	Rate pounds per acre	Percent plants killed			
		Big sage-brush	Little rabbit-brush	Big sage-brush	Big rabbit-brush
Tordon 22-K[1]	1.00	68.6	94.6	62.7	96.6
Tordon mixture 101[2]	1.50	51.8	90.8	35.8	95.4
Kuron[1]	3.00	86.6	55.8	90.3	75.8
Esteron 76-E[1]	3.00	89.6	63.5	92.4	80.3
Tordon 22-K and Kuron[2]	1.66	96.5	95.5	90.4	98.8
Tordon 22-K and Esteron[2]	1.66	95.4	96.3	92.1	97.6

[1]Applied on all locations 1963, 1964, and 1965
[2]Applied on all locations 1964 and 1965

esters of 2,4-D or 2,4,5-T with Tordon 22-K gave excellent kills of both sagebrush and rabbitbrush at all locations. It should be pointed out that Tordon 101 is a mixture of Tordon 22-K and 2,4-D but, in this case, the 2,4-D is a salt and not an ester as was used in the mixture with Esteron 76-E. This perhaps accounts for the effectiveness of the latter mixture in controlling big sagebrush.

FORAGE YIELDS

A frequently asked question is how much increased forage can be expected if brush is successfully killed? This depends upon the undesirable brush species, the extent of the invasion, the potential of the site, and the species and amount of understory present.

Naturally, the higher the potential of the site the greater the returns from brush control. It is generally agreed that at least 15 to 20 percent ground cover of desirable grasses should be present as understory to reoccupy the space released by the killed brush.

Research shows that big sagebrush is more competitive with range grasses than the rabbitbrush species and little rabbitbrush is more competitive with associated forage species than is big rabbitbrush. On the plots where the three brush species have been studied, various sites have been represented and the invasion of brush has varied widely in intensity. Production following spray has been determined on more than 1,000 plots of each of the three brush species studied. In all cases the increased production has been evaluated with percent brush cover controlled and potential of the site.

From these calculations a general formula can be presented for estimating the expected forage increase after brush is controlled. The formula was developed in areas where invasions of brush ranged from about 20 percent to about 50 percent of the canopy cover. The conversion factor changes somewhat with intensity of invasion but samples of light and heavy intensities were not sufficient to determine the extent of the change for any of the 3 species studied.

HOW TO FIGURE

As an example for calculation purposes, a site is believed to have a potential of 1,500 pounds of air dry forage per acre and the invasion of brush is estimated at about 30 percent ground cover. Brush cover would be estimated as normal plant cover or canopy without compacting the normal growth. The formula for estimating increased yield from brush control follows:

(Continued on page 23)

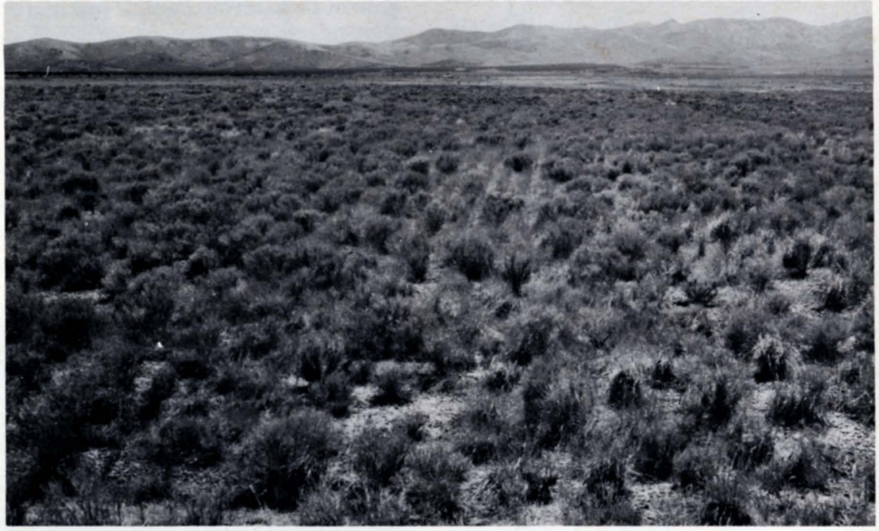

Figure 2. Invasion of big sagebrush and big rabbitbrush in a crested wheatgrass seeding near Vernon, Utah.

Figure 3. Spraying herbicide on a brush infested mountain range where subsequent grass yields increased as much as 1200 pounds per acre.

From physiographic data . . .

Estimation of Utah's Water Yield

JAY M. BAGLEY

For many years those concerned with water usage in Utah have talked of the need to develop a state-wide plan for the best utilization of the total manageable water supply. The first stages of such planning necessitate a state-wide overview of the geographic difference in runoff. It is common knowledge, however, that hydrologic records are inadequate in many areas to completely define these geographic water potentials. In 1951 Utah State University and the Utah Water and Power Board initiated a study to develop simple methods and techniques useful in making rapid and economical estimates of runoff in areas lacking such measurements. These estimates would then be utilized in outlining the geographic pattern of runoff over the entire state. This study has been completed and the results have been successfully used in obtaining a broad perspective of the state's water supply. The information thus attained is vital in first stage planning of a regional nature.

DETERMINING RUNOFF

When short time records of annual streamflow are available on a stream or tributary, the hydrologist can correlate these records with an adjacent or nearby stream having concurrent records but for a longer period. Such a correlation gives an estimate of the mean annual runoff. If no streamflow records are available, however, the hydrologist must look for other methods and techniques to estimate run-off.

Since the ultimate source of all available water is precipitation, and because records of precipitation are often longer and more abundant than streamflow records, it is quite common to try to establish relations between precipitation and runoff which can be used to estimate runoff where precipitation data are available. Many of our water yielding areas, however, also have very limited precipitation data. They are remote, sparsely populated, and characterized by abrupt differences in elevation in relatively short distances. Thus, the very areas where dense precipitation gaging networks are needed to accurately describe the precipitation pattern are those having the most sparse network.

ANOTHER APPROACH

Another approach to determination of the mean annual runoff is to relate certain physical or topographical features known to influence amount and distribution of precipitation. It is well known that amounts and disposition of precipitation are affected by physical or basin factors as well as the storm or climatic factors. Consequently, it would be expected that watershed yield would be affected in a similar way. This approach to obtaining estimates of runoff without having adequate data on precipitation, streamflow, etc., is an alternative born of necessity. It is an attempt to overcome, to a certain extent, the lack of hydrologic measurements. Consequently, if sufficient runoff data of good quality are available, a relation with corresponding physiographic features of a watershed, can be established. This in turn can be used to estimate runoff in areas where only the physiographic data are available. This,

Figure 1. Most available water in Utah comes from snow that falls in the mountains.

JAY M. BAGLEY is an associate professor in the Utah Water Research Laboratory.

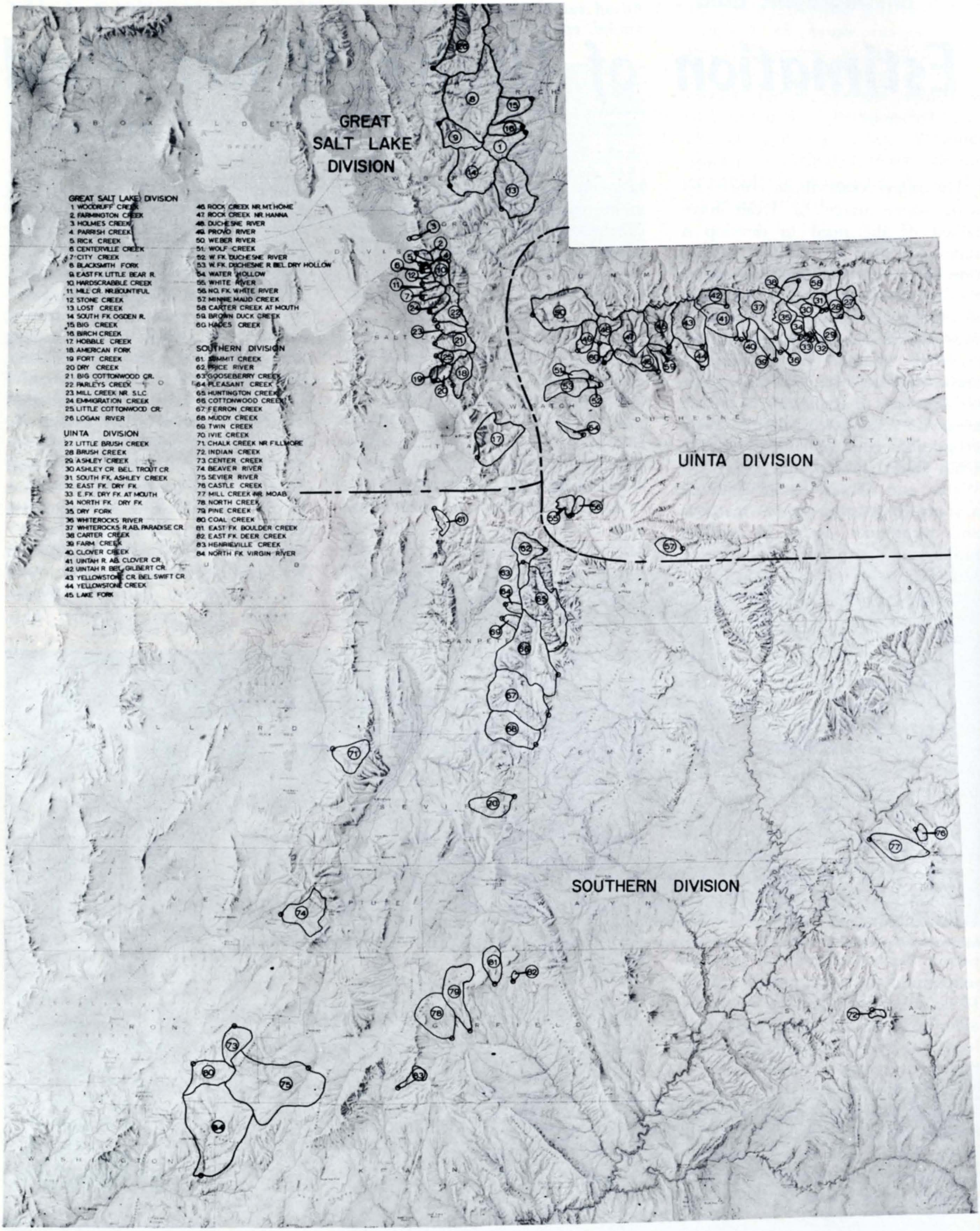

Figure 2. General location of watersheds selected for analysis and major hydrologic divisions.

in essence, was the aproach used in this study.

PHYSIOGRAPHIC FACTORS

Such drainage basin or physiographic factors as land use, soil type, geologic structure, basin area, shape, elevation, slope, aspect, and drainage density are important in their effect on the disposition of precipitation and subsequent streamflow. The influence of some of these factors is not strictly independent of climatic factors. For example, the mean elevation of a watershed has a definite relation to temperature and precipitation and thus bears an important relation to consumptive losses as well as amount and form of precipitation that might occur. Likewise, the general orientation of a watershed may affect evaporative losses because of its influence on the amount of heat received from the sun. It may also affect precipitation amounts, depending on the prevailing wind direction. Drainage density may be an index to the nature of soil and geologic structure of a basin.

Although there are many topographic and physiographic factors which affect water yield or runoff, practical consideration would limit the factors considered to those which could be easily measured or for which the data are readily available. The objective, therefore, was to select rather simple factors or index parameters which might be indicative of the net effect of a principal influencing factor or factors.

A lengthy discussion concerning data collection and analysis cannot be given here (see note at end of story). Suffice it to say that precipitation data and streamflow data were exhaustively collected and evaluated in terms of their adequacy for use in analysis. The customary problem of varying record lengths required extending many records by standard procedures to make them span uniform periods of time. Also, as in any hydrologic problem, the number of stream-gaging stations having long time total annual flow records and for which there are no upstream diversions is somewhat limited. Streamflow records of some 84 watersheds were utilized. Their location and geographic distribution can be seen in figure 2.

PHYSIOGRAPHIC DATA

Appraisal of mean annual water yield must recognize the influence of many drainage basin characteristics. These have been referred to above. As indexes to many of these important factors the following data were obtained from topographic maps:

1. The area of the watershed
2. The mean elevation of the watershed
3. The maximum elevation of the watershed
4. The drainage density
5. The average slope of the main streambed
6. The aspect of the watershed
7. The average slope of the land within the watershed in the north-south direction
8. The average slope of the land within the watershed in the east-west direction
9. The mean overall land slope of the watershed
10. The longitude and latitude of the approximate center of the watershed
11. The distribution of area with respect to elevation

In addition, geologic data and vegetation cover information were obtained for many, but not all, of the watersheds selected for study.

STATISTICAL ANALYSIS

Because of the many factors affecting runoff, the inability even to recognize some of them, and the lack of precision in describing them quantitatively, it is virtually impossible to set up precise mathematical relationships for predicting water yield. Multiple regression and correlation techniques have been used extensively as aids in discovering relationships and testing the significance of these relationships for situations where a large number of factors need to be evaluated simultaneously. Such statistical approaches have the appealing features that individual and relative effects of the factors can be tested; indexes to the reliability can be determined and estimation equations can be derived.

RESULTS

The first major statistical analysis utilized data from streams and watersheds throughout the state. Results of this state-wide analysis gave less precision than is desirable in estimating water yield. Consequently, the state was divided into more homogeneous hydrologic divisions for further analyses. Three hydrologic divisions were developed; the Great Salt Lake, Uintah, and Southern divisions. These are outlined in figure 2.

More than 122 predicting equations were derived for estimating water yield. Various combinations of the physiographic and other characteristics were employed to discover which were the most significantly correlated with water yield. Standard statistical tests were used to evaluate the estimating precision and reliability of each equation. The analyses and relations thus obtained provided the means of making good estimates of water yield. Consequently, it was possible to fill in the data gaps and obtain a state-wide picture of mean annual runoff.

ISOGRAMS

Figure 3 is an isogram of runoff showing the mean annual pattern by a series of lines connecting points of equal runoff expressed as depth. Such a map provides a concise visual presentation of surface water production. It can be used effectively in preliminary studies of various kinds and gives an immediate visual recognition of potentials and limitations in broad perspective. A runoff map such as figure 3 cannot be expected to show the fine detail necessary for examination of extremely small basins nor for solution of specific design problems where a high degree of reliability is necessary. Actually figure 3 is a composite of fourteen smaller scale maps on which the original isolines were drawn. Transparent prints of the runoff maps at the 1:250,000 scale have been prepared to be used as overlays with the Army Map Service topographic maps of the same scale. Any basin or region of interest can be outlined on the regular topographic maps, the overlay placed over it, and the

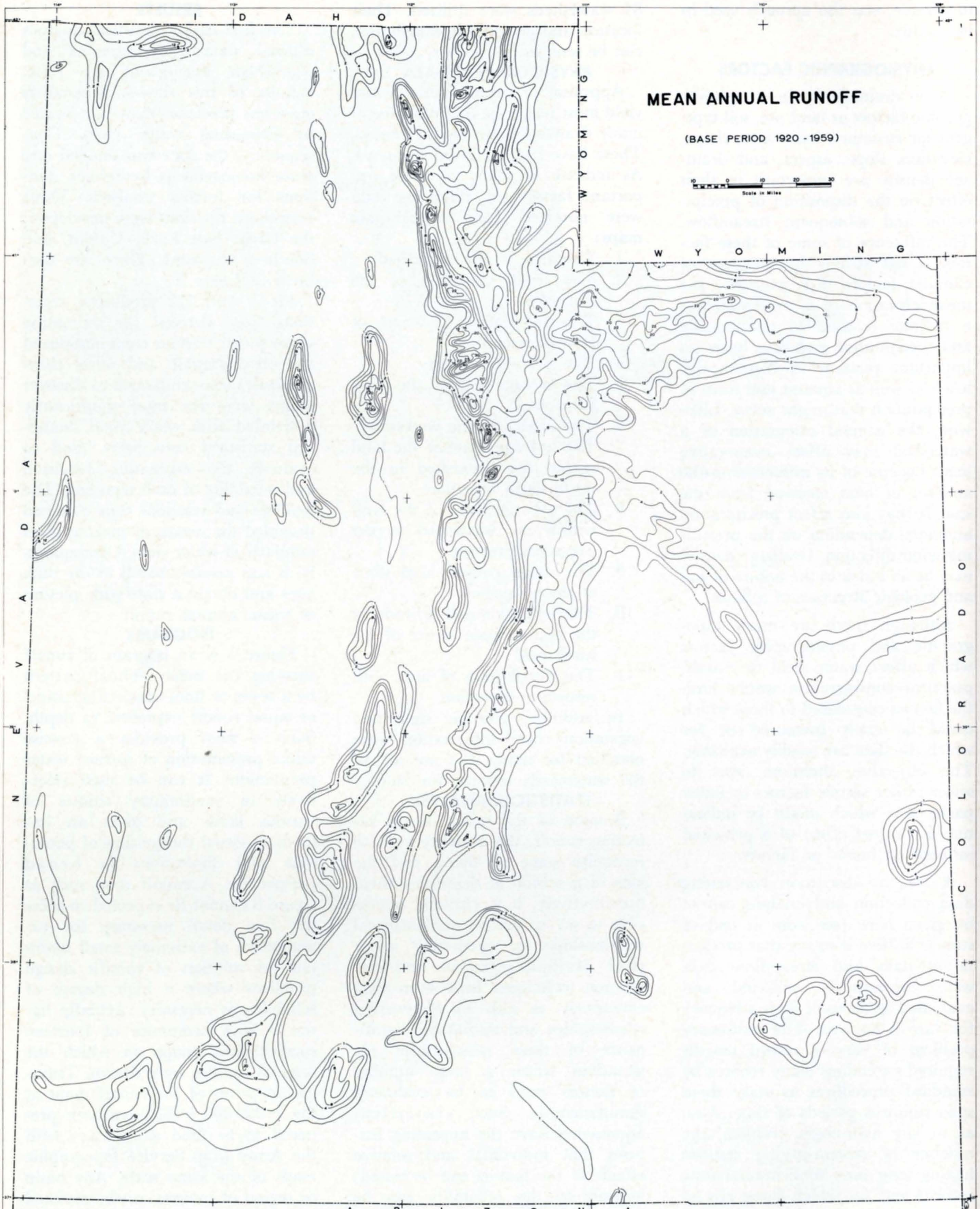

Figure 3. Isolines (lines connecting points of equal precipitation) of mean annual runoff from precipitation falling on Utah.

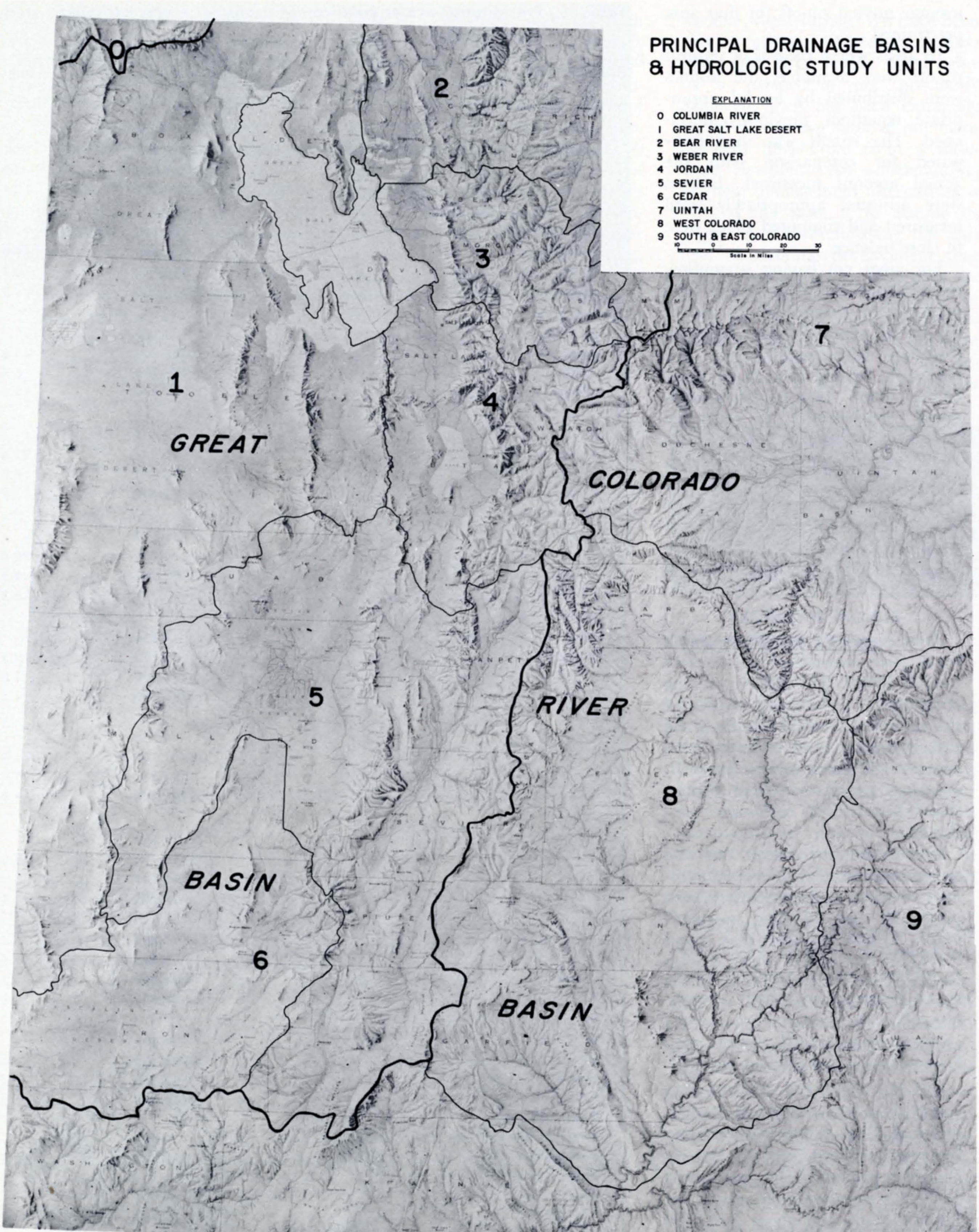

Figure 4. Principal drainage basins and hydrologic study units of Utah.

average annual runoff for that area determined.

In areas where records of natural runoff were available, the isolines were distributed by use of appropriate equations previously developed. The runoff was then computed for comparison with the actual amount measured. Isolines were adjusted appropriately until measured and computed yields were in close balance.

For areas not having streamflow records, locations of iso-runoff lines were largely determined by use of the better relations which included elevation and precipitation. The previously located lines in the areas having runoff data served as additional "bench-marks" to guide the location of iso-runoff lines in areas having no data with which to check results. The isolines were drawn in without regard to the possible effect of storage or diversion. Runoff quantities calculated by use of these maps would represent expected natural runoff.

RUNOFF INVENTORY

Mean annual runoff in Utah varies from essentially none to more than 40 inches. The highest yielding areas appear to be in the vicinity of the Little Cottonwood Canyon along the Wasatch Front. Other areas along the Wasatch Range in northern Utah and in the Uintah Mountains are relatively high water producers.

Calculations of runoff for the entire state and for selected hydrologic divisions of the state have been made by use of the iso-runoff maps. Results indicate that about 8,551,000 acre-feet of water emerge from the water yielding areas in the streams and tributaries of the state. This quantity of water represents a uniform equivalent depth of about 2 inches over the area of the state.

Of the 8,551,000 acre-feet of runoff from the streams and tributaries of Utah, about 54,200 acre-feet are developed from the Columbia Basin portion of the state, about 4,880,000 acre-feet from the Great Basin portion, and about 3,617,000 acre-feet from the portion within the Colorado River Basin. In other

Table 1. Precipitation-water yield comparisons for major hydrologic study areas of Utah

Hydrologic unit	Acre-feet	Inches
0. Columbia River		
area (sq mi)	404	
precipitation	389,200	18.1
runoff	54,200	2.5
difference	335,000	15.6
1. Great Salt Lake Desert		
area (sq mi)	16,384	
precipitation	7,838,900	9.0
runoff	606,000	0.7
difference	7,232,900	8.3
2. Bear River		
area (sq mi)	3,152	
precipitation	3,326,900	19.8
runoff	1,039,100	6.2
difference	2,287,800	13.6
3. Weber River		
area (sq mi)	2,462	
precipitation	2,996,900	22.8
runoff	908,900	6.9
difference	2,088,000	15.9
4. Jordan River		
area (sq mi)	3,753	
precipitation	4,074,200	20.4
runoff	980,100	4.9
difference	3,094,100	15.5
5. Sevier River		
area (sq mi)	11,214	
precipitation	7,982,900	13.3
runoff	1,074,000	1.8
difference	6,908,900	11.5
6. Cedar		
area (sq mi)	5,289	
precipitation	3,647,100	12.9
runoff	271,900	1.0
difference	3,375,200	11.9
7. Uinta		
area (sq mi)	11,045	
precipitation	9,738,100	16.5
runoff	1,984,200	3.4
difference	7,753,900	13.1
8. West Colorado		
area (sq mi)	15,508	
precipitation	9,362,200	11.3
runoff	981,200	1.2
difference	8,381,000	10.1
9. South and East Colorado		
area (sq mi)	14,007	
precipitation	8,817,100	11.8
runoff	651,400	0.9
difference	8,165,700	10.9
Great Salt Lake		
area (sq mi)	1,773	
precipitation	978,800	10.4
State of Utah		
area (sq mi)	84,991	
precipitation	59,152,300	13.0
runoff	8551,000	1.9
difference	50,601,300	11.1

words, less than 1 percent of the yield from Utah is in the Columbia River Basin, about 57 percent from the Great Basin, and about 42 percent from the Colorado River Basin.

Runoff and other hydrologic information is required according to a variety of geographic and hydrologic areas. The mean runoff totals indicated above for the three major river basins can be further subdivided according to appropriate geographic areas as needed. Figure 4 indicates a further breakdown into 10 such hydrologic regions. Mean annual runoff has been calculated for each region and is tabulated along with corresponding precipitation values in table 1.

Other precipitation-water yield relations have been examined. For example, an indication of the change in average runoff (and precipitation) that occurs as larger areas are included (beginning with the high elevation areas) is given in figure 5. This figure shows that almost 80 percent of Utah's runoff is contributed by only about one-fifth of the area. This major water-producing area, generally above 7,000 feet, receives about 25 inches of precipitation annually and yields about 8 inches of runoff. This indicates that about 17 inches of water are lost annually from these lands. This loss would be primarily evapotranspiration, although an undetermined portion could be comprised of underground flows not measured at regular gaging stations.

SUMMARY

The tools and information gained from this study have permitted a much better insight into the magnitude, geographic distribution, and general characteristics of our manageable water supply. We have been able to prepare hydrologic budgets by major river basins which give us a perspective not previously achieved. This has been extremely useful in assessing some of our management possibilities from a statewide viewpoint. An understanding of these management alternatives is vital if the state is to assume its proper role in establishing the pattern of resource development that accomplish particular objectives for its residents. The resurgence of state activity, influence, and orientation toward development has most certainly been affected by the acquisition of a broad appreciation of its hydrology.

NOTE

For more complete discussion of analyses and results see "Water Yields in Utah," Special Report No. 18, Utah Agricultural Experiment Station, Utah State University, Logan. Utah. September 1964.

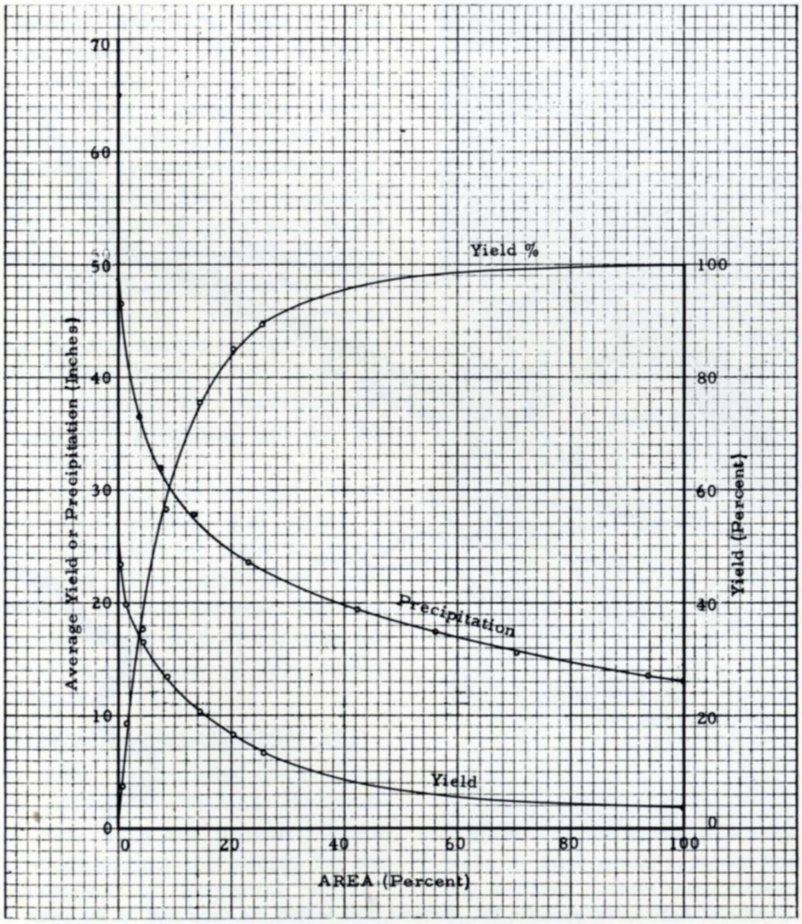

Figure 5. Precipitation - water yield relations for Utah.

WHO PAYS TAXES?

(Continued from page 8)

from the property tax. This tax has a particularly heavy incidence on farmers, and to a lesser extent, on the self-employed. It also creates a heavy burden on lower income retired families. This heavy burden has stimulated interest in seeking property tax relief, or at least in holding the line on further increases in property taxes.

Farmers and the self-employed, by the nature of their businesses are large property holders, and for this reason might be expected to pay more property taxes than the average person. This is particularly true if more benefits from public services are received. But serious questions of equity and the need for tax adjustments can certainly be raised when one group of taxpayers carry a combined sales, property and income tax burden more than two and one-half times as heavy as most families and twice as heavy as any other occupational group.

COMMUNITY WATER DEVELOPMENT IN ASHLEY VALLEY

RICHARD E. GRIFFIN and BEN W. LINDSAY

Ashley Valley is a vast rugged valley in "dinasour land," eastern Utah. The Green River cuts a flaming gorge through the Uintah Mountains and winds down the eastern side of the valley.

When the Mormon pioneers settled Vernal in 1875, they struggled to combat the long cold winters and unpredictable summers. Drought and crop failures were regular occurences. Today things are different. Vernal is a growing, prosperous city. Steinaker Dam, just north of Vernal and a central office for the irrigation companies stand as evidence of change and progress. Recent development of oil and water resources in the area has brought new life to the valley.

The first settlements were located along Ashley Creek and water was diverted into small ditches to water their crops. One such ditch extended for 8 miles and was later expanded into what is now the Central Canal. Figure 1 shows the present system of canals.

WATER PROBLEMS

As winter snows in the Uintah Mountains began melting in the spring, the pioneers would watch as Ashley Creek became a rushing torrential river gouging out trees, bridges, and even homes along its path. In July, when crops needed the water most, it was gone. Figure

RICHARD E. GRIFFIN is Extension Water Resource Specialist. BEN W. LINDSAY is the former Extension Agent for Uintah County.

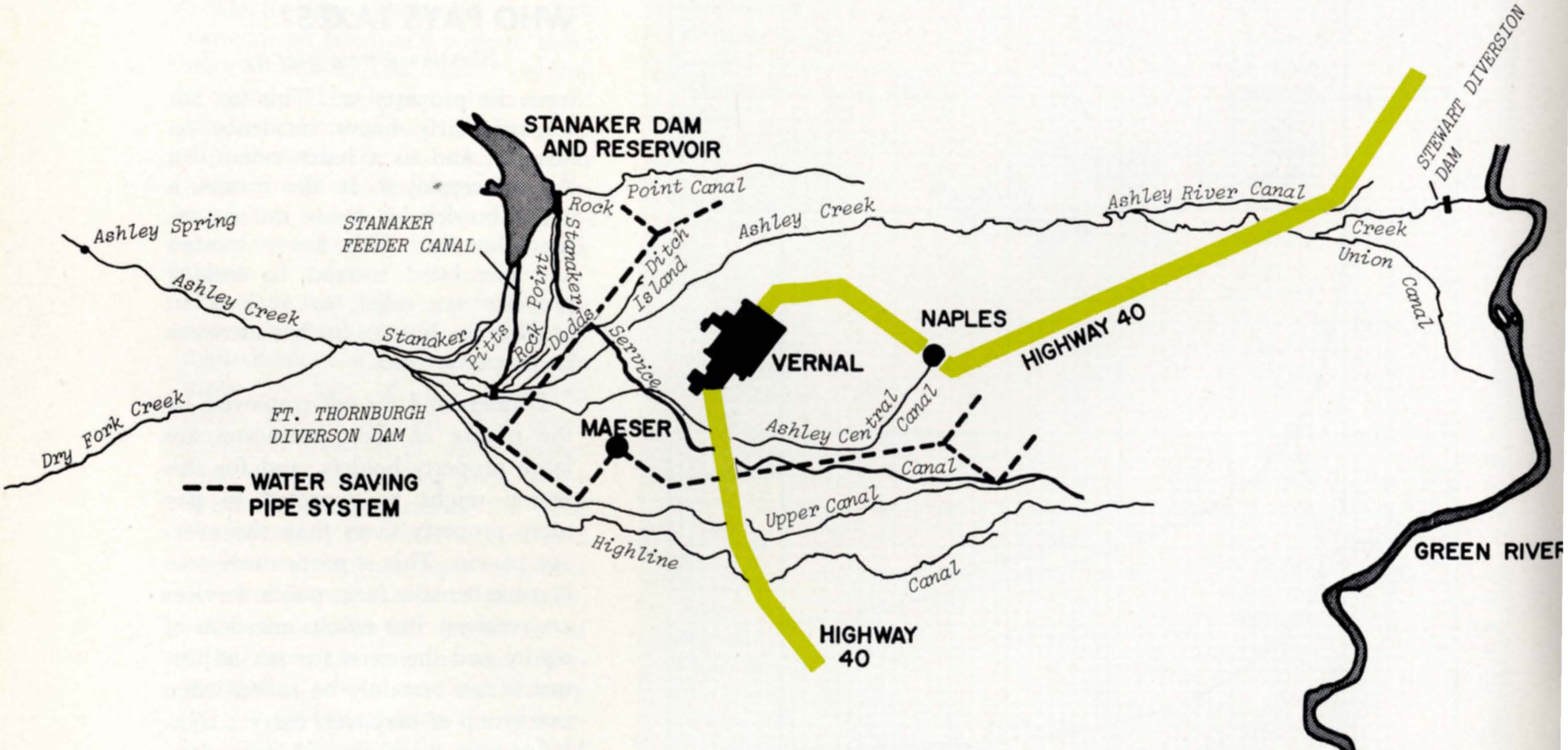

Figure 1. Chronic water shortages have plagued the people of Ashley Valley since the pioneers first settled the area. But as the years passed canals were dug and the available water resources were developed.

3 shows a comparison between the flow in Ashley Creek and pre-dam crop needs.

A major tributary to Ashley Creek known as Dry Fork has a good streamflow which lasts well into the late summer. Dry Fork Creek got its name, not because it dries up, but because it passes through a valley called "The Sinks" and that is just what the water does — sinks into the ground. Industrious pioneers, who were experts at community development, went to Dry Fork Canyon in 1894 and constructed a saw mill to provide lumber for construction of a wooden flume across The Sinks. Water leaked from the flume, however, and caused the soil under the supporting trestles to give way thus toppling and wrecking the flume. After several unsuccessful attempts, at what today is considered a major engineering undertaking, the project was abandoned.

A more successful community water project was the construction of storage reservoirs high in the Uintah mountains. Six such reservoirs were made with horse drawn scrapers. Most of these were formed by enlarging existing glaciated lakes. Some of the dams were made of logs. These reservoirs have a combined storage capacity of more than 6,000 acre-feet and have proved a benefit to farmers. Before Steinaker Dam was constructed, these reservoirs were the only source of late summer water. After Ashley Creek began to dry up, water in the reservoirs was released for irrigation use in the mid summer.

But this was not enough. More water was needed and many a farmer dreamed of ways to catch the spring floods and store them for use in the hot summer. But this required money and equipment far beyond the means of the valley inhabitants.

NATIONAL RECLAMATION ACT

In 1902, The United States Congress passed the National Reclamation Act. This act provided funds for "examination and survey for the construction of irrigation works." All beneficial uses were to be taken into account including irrigation, hydro-electric power, municipal supplies, fish and wild life, recreation, flood control, and ground water.

The development of the Colorado River and its tributaries has been possible because of the National Reclamation Act. The Roosevelt Dam on the Salt River in Arizona and the Strawberry reservoir in Utah were among the first projects to harness the Colorado. The construction of Hoover Dam proved to the world that large dams could be built successfully.

The Central Utah Project is a combined effort by the people of the state to develop Utah's share of the Colorado River. The Vernal Unit, of which Steinaker Dam is a part, was the first phase of the

Figure 2. Early settlers in Ashley Valley tried to build a flume to carry the waters of Dry Fork over The Sinks. Leaking water continually undermined the supports shown here and the project was abandoned in the early 1900's.

Central Utah Project of the Colorado River.

Funds and engineering are provided by the Federal Government through the Bureau of Reclamation and most of these funds are repaid through the sale of water and hydroelectric power. Recreation facilities, and flood control absorb the rest of the costs.

WATER SUPPLY AND DEMAND

Rights to the flow of Ashley Creek were adjudicated and a decree written in November, 1897 in the Fourth Judicial Court of the State of Utah. Ten canal and irrigation companies distributed the water under this decree.

Irrigation companies were formed as early as 1897 with the last one organized in 1913. The companies divided the natural flow of Ashley Creek and delivered it on a turn basis. Each farmer took the water when his turn came whether his crop needed it, and it often came when he was busy with other crops. This system has resulted in inefficient irrigation practices and loss of water, but it was probably the only system the pioneers could adopt without storage reservoirs.

Even in March and April the supply was inadequate to meet the needs, as can be seen in Figure 3. Part of this deficiency was supplied from winter snows and spring rains which filled the ground reservoir. However, drought and crop failure in the late summer months were an accepted occurance.

STEINAKER DAM

It is difficult to say who thought of Steinaker Dam first. The pioneer settlers dreamed of it and men like Briant H. Stringham, Leon P. Christensen and Hugh B. Colton of Vernal kept the dream alive. United States Bureau of Reclamation records show that active planning was under way in the early 1940's. A project planning report was submitted by E. O. Larson, Regional Director of the Bureau of Reclamation, in January 1949, outlining plans and feasibility of the dam.

Even before World War II, the Vernal Lion's Club initiated a program and promoted the Colorado

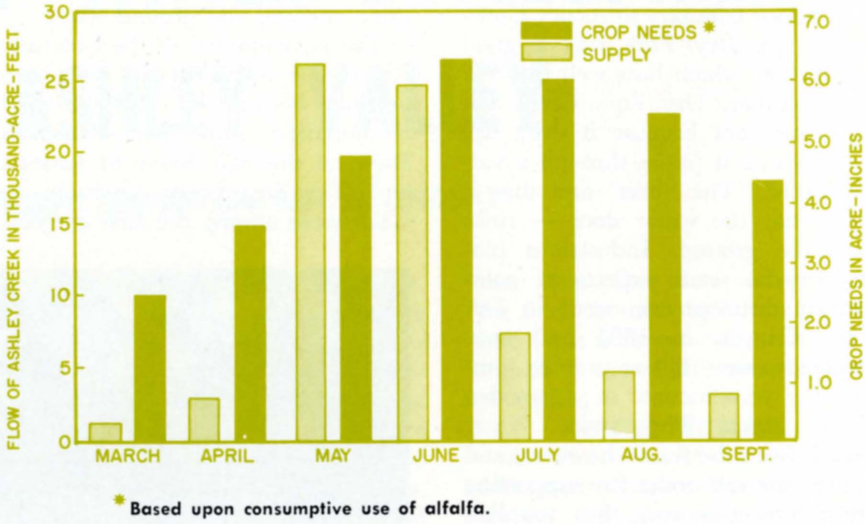

Figure 3. The average water supply in Ashley Creek (1930-1956) in comparison to crop needs in Ashley Valley.

River Storage Project. Through donations, a revolving fund was set up to provide the finances necessary to push the program.

Following World War II the Vernal Chamber of Commerce was organized and began actively promoting development of the upper Colorado River. This resulted in the formation of the Uintah County Colorado Development Committee with Briant H. Stringham as Chairman and L. Y. Siddoway as Secretary. This committee intensified the efforts and made it possible for the Uintah County Commissioners to contribute to the revolving fund.

The next step was formation of the 21-county Colorado River Development Association. This association represented those Utah counties that would receive benefits from the Colorado River.

The people in Ashley Valley actively supported the organization of these committees and Wyoming, Colorado, and New Mexico joined with Utah to push the program in the United States Congress.

After several years of hard work by the Upper Colorado River Commission, the respective state water agencies, and other interested committees, the Upper Colorado River Storage Project bill was passed by Congress in 1956.

Construction on Steinaker Dam started in 1958 by the Bureau of Reclamation and was completed in 1963. It is an earth-filled structure 140 feet above stream bed and 2,400 feet long at the crest. It forms an off-stream reservoir located about 3 miles east of Ashley Creek. A small diversion dam diverts the water of Ashley Creek and it is conveyed to the reservoir through a feeder canal. Steinaker Dam cost about $7 million.

The reservoir has a capacity of 36,000 acre-feet of which 18,000 acre-feet of water will be available for irrigation each year. About 12,000 acre-feet are held in reserve for dry years and 6,000 acre-feet are retained for fishing, boating and other recreation.

CULINARY WATER SYSTEM

Before Steinaker Dam was constructed, water flowed in the canals through the winter to provide drinking water for livestock. This water was needed to store in the reservoir, so the Federal Government provided funds through the United States Bureau of Reclamation for the installation of 17 miles of pipe in two main lines to supply water to farms and homes throughout the valley.

This project was expanded when Vernal and Maiser turned project water into their mains and it became a valley-wide municipal water system. Good drinking water was provided to homes throughout the entire valley by cooperative financing; $400,000 in Federal funds, $600,000 from Vernal and $60,000 from Maiser. Today about 400 additional valley homes have been connected to this system.

CENTRAL IRRIGATION OFFICE

As Steinaker Dam became a reality, the irrigation companies of Ashley Valley soon realized that the increased supply of water would be expensive and it would be necessary to distribute it as efficiently as possible. Crops no longer would be dependent upon natural streamflow, but good management would be necessary to assure an adequate water supply for the hot summers.

These companies requested the Utah State University Extension Services to help develop a method of water delivery and record keeping. Former Extension Water Use Specialist, Dr. Bruce Anderson and Extension Agent Ben Lindsay held meetings with the irrigation company officials, Bureau of Reclamation, Soil Conservation Service, and Conservancy District officials to formulate plans and objectives.

These meetings resulted in the following recommendations: (1) A central office be organized where all the business of the irrigation companies could be handled. (2) A manager be hired for the office and the chairman or president of each company form a committee or board of directors for the Central Office. (3) A communication system be established for irrigators, water masters and the Central Office. (4) Water masters be schooled on water policy and system procedure. (5) Irrigation structures be re-built or improved so that water deliveries could be measured. (6) Water be ordered and recorded in acre-feet and an up-to-date account be kept of the amount each water user has used. (7) Water delivery would be changed from a rotation system to a call or demand system.

The Central Office did become a reality. Officials of four canal companies, Dee Jinkins, chairman of the Upper, Colton McKeachnie, chairman of the Highline, Lowe Goodrich, chairman of the Central Canal and Lynn Richins of the Ashley Valley Reservoir approved the recommendations and the Central Office committee was formed in

Figure 4. Steinaker Dam is located 3 miles north of Vernal. A dream come true for the people of Ashley Valley, it provides boating and fishing recreation and it virtually removes the threat of drought.

May 1964 with these men as members. Dee Jinkins was elected chairman. Later, the Rock Point Canal Company joined and Lew Sowards became a committee member.

Irrigation company records were transferred from private homes to the office located in downtown Vernal. The records, business, and stock valued at $1.8 million are now consolidated and administred in one conveniently located office run by David Rassmussen, manager, and John Hacking, secretary. With improved office facilities and procedures, including card files and name plates for IBM mailing, the Central Office rapidly gained a reputation as an efficient place to transact the business of water ownership and delivery.

Instructions were given to water users, water masters and ditch riders on procedures for requesting water and each shareholder was informed in the spring how much water he could anticipate. Water users now order their water direct from the Central Office.

The problems of accounting for and delivering water are not simple and easy for the Central Office, but their solution is easier than formerly when business was usually conducted on someone's front lawn or in the field. Some of the difficulty of administration results because there are three sources of water rights: (1) primary and secondary water from natural streamflow, (2) water from the reservoirs in the high mountains, and (3) water from Steinaker Reservoir. Some canal companies have only secondary water rights, while others have all three water rights. However, the Central Office has done a remarkable job of supplying water under these conditions. It has meant careful accounting and accurate records and while it is difficult now, under the old system it was often impossible for water masters who kept their records in a booklet carried in their hip pockets.

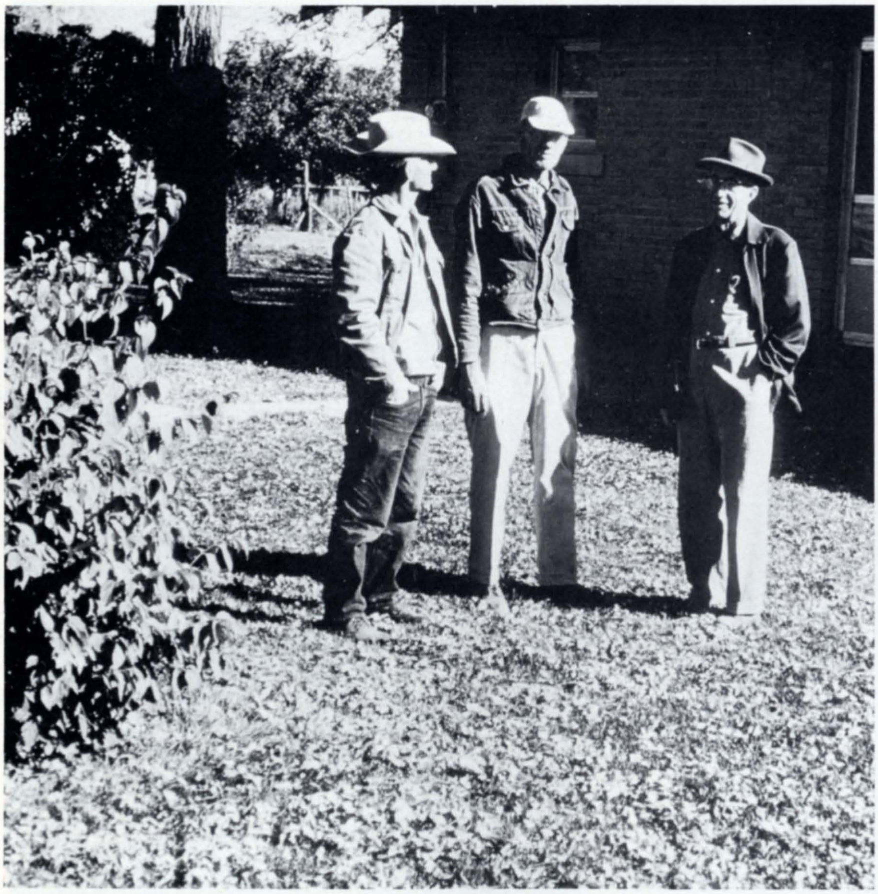

Figure 5. Irrigation canal company business was often conducted on some front lawn before the establishment of a central office.

COST OF WATER

Steinaker Dam and the formation of the Central Office have increased the cost of water. At the same time, they have given the farmer an assured supply of water that has resulted in increased production.

Before Steinaker Dam was built, a farmer could expect to get about 2 acre-feet of natural stream water for each acre at a cost of $.50 per acre-foot and 1 acre-foot of high mountain reservoir water at $2.50 per acre-foot.

Three acre-feet of water per acre might be enough to grow a crop in Ashley Valley, but most of this water was gone before it was needed.

Water from Steinaker Reservoir is estimated at $2.75 per acre-foot. Efficient water users, however, have reported that 1 acre-foot from Steinaker Reservoir has been adequate to supplement their present supply.

PRODUCTION

Not enough time has elapsed to determine accurately the increased production resulting from Steinaker Dam and better distribution methods by the Central Office.

However, farmers are reporting that alfalfa land, just poor pasture before, is now producing 2 to 3 tons per acre. Alfalfa land producing 2 to 3 tons per acre before, is now producing 4 to 5 tons. Barley production has increased as much as 50 bushels per acre. Most important, farmers feel that crop failures due to drought are a thing of the past.

WHAT OF THE FUTURE?

The construction of Steinaker Dam and the establishment of a central irrigation office were not the end of community efforts in Ashley Valley. Already such committees as the Central Office Committee and the Uintah County Conservancy Disdrict are at work to bring more land into production and provide an adequate future supply of water for industrial and city use by developing water from Dry Fork.

The Central Office, Extension Service, Conservancy District, and Soil Conservation Service are busy seeking ways to eliminate excessive seepage losses of water from the canals. Plans include eliminating the Upper Canal and enlarging the Highline Canal to carry the water of both canals. This new canal would then be lined and distribution laterals would be constructed with pipe. Water could then be delivered to farmers under pressure. In addition, operation and maintenance costs would be greatly reduced.

Other future goals include a complete call system of delivery, better access roads along the canals, and better measuring and turnout structures, all of which lead to better production and a more abundant life through combined efforts of everyone.

The Bureau of Reclamation is actively studying the underground water potential and experimental wells are being drilled. Drainage of water-logged lands will be tested in an effort to make these lands more productive. This project will be underway in the spring of 1966.

Change and progress take place slowly. Yet Ashley Valley is an example of the progress which can be made when people are willing to unitedly spend time, effort, and work toward the betterment of their community.

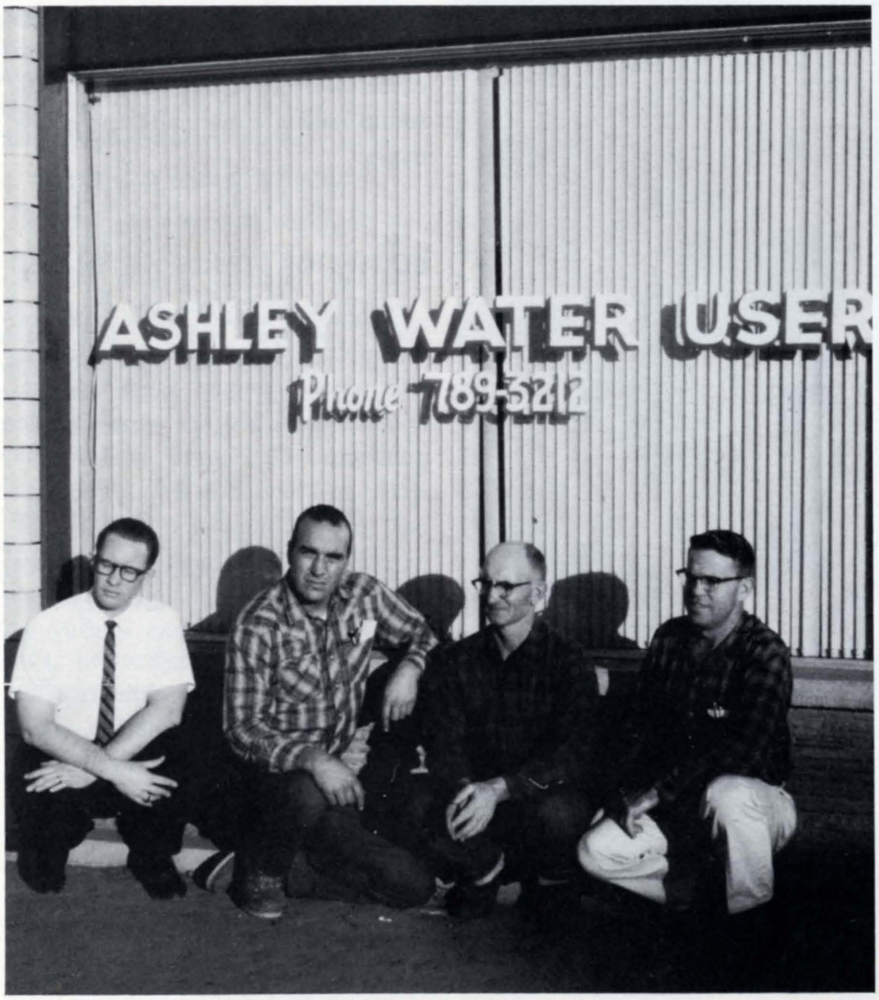

Figure 6. The new central irrigation office for Ashley Valley is located in downtown Vernal. Pictured in front are John Hacking, office secretary; David Rassmussen, office manager; Dee Jinkins, chairman of Central Office Committee; and Ben Lindsay, former Uintah County Extension Agent.

HERBICIDES

(Continued from page 10)

Increased yield = (% canopy cover of brush) (conversion factor) (site potential in lbs./A).

The suggested conversion factor is 1.3 for big sagebrush, 0.9 for little rabbitbrush and 0.8 for big rabbitbrush. With a canopy cover for big sagebrush of 30 percent and the site potential of 1500 pounds of air dry forage per acre, the calculation would be (.30) (1.3) (1500) = 585 pounds per acre increase in forage yield. If the canopy cover was 40 percent and consisted of big rabbitbrush the calculation would be (.40) (0.8) (1500) = 480 pounds per acre increase in forage yield.

When the invading brush is a mixture of two species the conversion factor would necessarily be an average of the two species weighted by abundance of each. For instance, if the area were invaded by a mixture of 25 percent big sagebrush and 75 percent little rabbitbrush the weighted average would be 1.0. If the area has a total canopy cover of 40 percent where the site has a potential of 1200 pounds of air dry forage per acre, the calculated forage increase from brush control would be (.40) (1.0) (1200) = 480 pounds per acre.

It must be remembered that only the usable portion of the increased herbage yield resulting from spraying represents increased carrying capacity of the range. For instance, where the potential of the range area is 1500 pounds per acre, the proper use of the understory grasses may be only about 60 percent of the current growth. Therefore, in the example where an additional 585 pounds of forage per acre were obtained by controlling the 30 percent cover of sagebrush only 351 pounds of usable forage per acre might result.

DON'T FORGET

Please let us know if you wish to continue receiving Utah Science. In accordance with postal regulations, we are revising our mailing list and adding ZIP CODES. Please check your zip code and return this post card request.

—the editor

Researching the Chemistry

Human beings have traditionally, and with cause, been fearful of and puzzled by the violent action of venoms from such small creatures as poisonous snakes. The amount of venom injected by these snakes is usually very small; but in many cases the results are fatal. Symptoms arising in the victim from being struck by a poisonous snake result from the combined effect of complex protein components present in the venom. Systematic scientific study on snake venoms was begun about 30 to 40 years ago with the main emphasis on the physiological and drug-like actions of the venoms. Recently many scientists have intensified their investigation of the chemical nature of snake venoms.

Snakebites are a serious public health problem in many parts of the world. In North America, including Mexico, the number of annual deaths from snakebites is between 300 and 500. In the United States, it has been estimated that approximately 2,000 to 3,000 individuals are bitten each year by rattlesnakes *(Crotalus)* and copperheads and water moccasins *(Agkistrodon)*, resulting in the deaths of about 15 persons. In South America, however, annual snakebite deaths range from 3,000 to 4,000. In southern and southeastern Asia (excluding China), corresponding figures range from 25,000 to 35,000. Therefore, a better understanding of snake venom action and of the actual cause of death in cases of snake bite would facilitate more effective treatment.

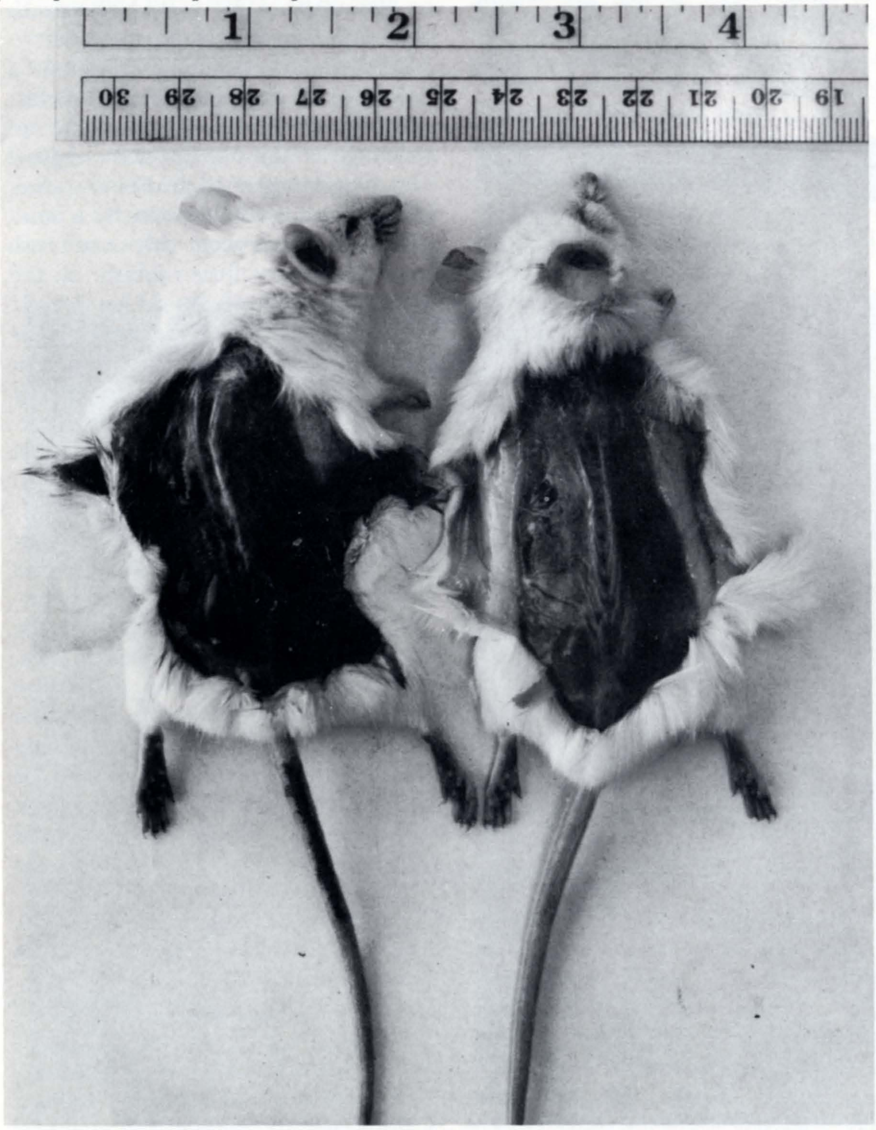

Figure 1. Hemolysis caused by venom of crotalid when injected subcutaneously (under the skin) into mice. Prairie rattlesnake venom was injected into the mouse on the left while the control on the right was injected with water. Note that the skin of the water-injected mouse is not bloody.

CLASSES OF POISONOUS SNAKES

There are about 2,000 types of snakes in a great variety of forms and sizes. Among these species, about 270 to 300 are known to be poisonous. Of 13,745 snakes collected in Panama in 1 year, poisonous snakes numbered 3,275 (24 percent). Percentages may vary depending on the geographical location.

According to the similarity in appearance, bone structure, and other zoological characteristics, the poisonous snakes are classified into the following four *families*:

1. Crotalid *(Crotalidae)* — Includes rattlesnakes, copperheads, and water moccasins.
2. Viperid *(Viperidae)* — Such as russell's vipers and puff adders.

# of Snake Venom

ANTHONY T. TU
PAUL M. TOOM

3. Elapid *(Elapidae)* — This group includes coral snakes, cobras, and kraits.
4. Sea snakes *(Hydrophiidae)* — Snakes that live in the oceans.

ANTIVENOM OFTEN INEFFECTIVE

Specific antivenoms are highly effective, but they are also highly specific and ineffective for the bites of species widely separated in racial and geographical origins. For instance, antivenom for Formosan cobra *(Naja naja atra)* is ineffective for treatment of poisoning by Thailand cobra *(Naja naja siamensis)*. It is also reported that antivenom prepared for venom of rattlesnakes from northern Brazil *(Crotalus durissus terrificus)* does not prevent deaths of persons bitten by specimens from southern Brazil.

WHAT IS A SNAKE VENOM?

Venom is not composed of a single substance common to all poisonous snakes, although almost all venoms do consist of approximately 90 percent protein. The proportions of the different substances in venom and their specific characteristics vary among the species. Any given snake venom usually contains more than one toxic principle, and these tend to act in combination with one another. The toxicity is caused by both enzymes and non-enzymatic proteins. The various enzymes may produce shock, hemorrhage (destruction of capillaries), necrosis (death of living tissue), hemolysis (liberation of hemoglobin from red blood cells), blood clotting, and non-coagulation, or some combination of these effects. The precise determination of the toxic principles of snake venoms is complicated by the affects on surrounding tissues that result when certain active substances such as histidine, adenosine, bradykinin,

•

ANTHONY T. TU is an assistant professor in the Chemistry Department. PAUL M. TOOM is a graduate assistant.

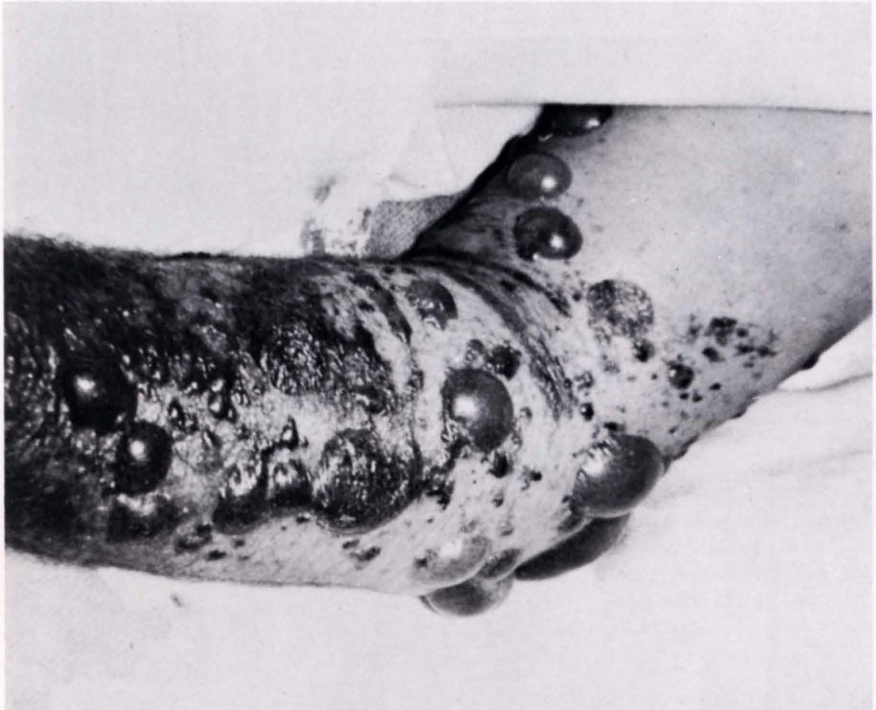

Figure 2. Necrosis caused by rattlesnake bite on human arm. It is believed that this reaction is related to the digestive enzymes in the venom.

Figure 3. Necrosis of a foot resulting from a rattlesnake bite. Note the difference between the bitten and the normal foot. The fang marks are on the heel of the left foot. Figures 2 and 3 were supplied by Dr. Findlay E. Russell, Director, Laboraotry of Neurophysiology, Los Angeles County General Hospital.

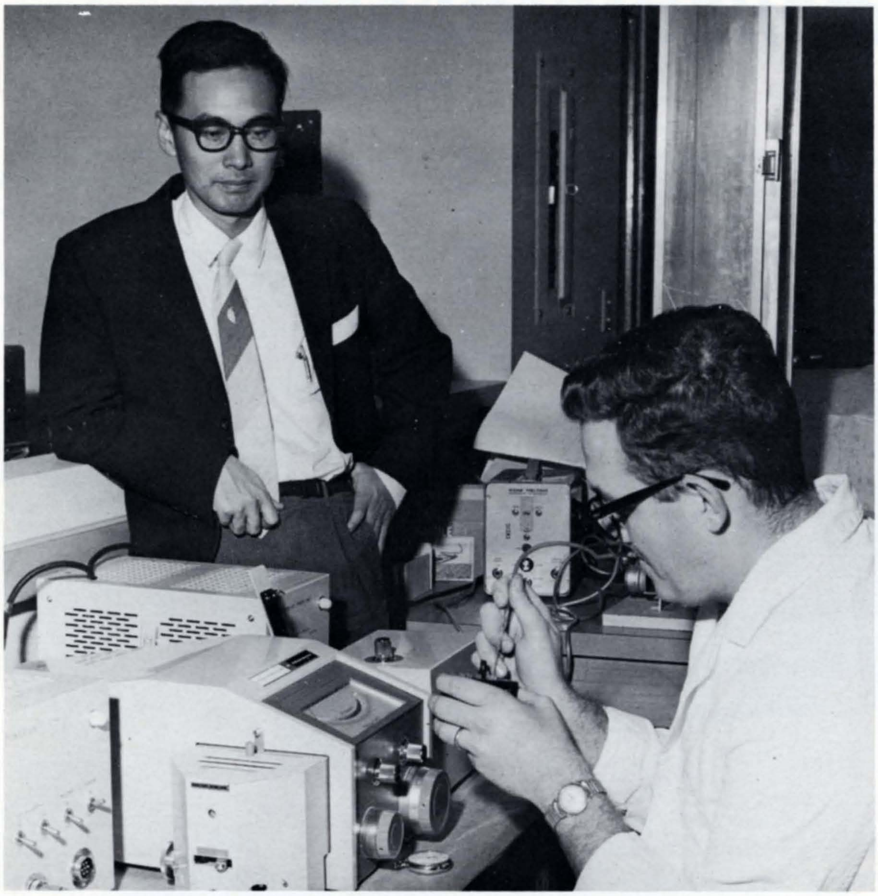

Figure 4. Dr. Anthony T. Tu and Richard B. Passey determine the activity rates of a snake venom proteolytic enzyme. This activity is followed by using an ultraviolet spectrophotometer.

heparin, and blood clotting agents are released from wounded tissues.

ENZYMES CAUSE DAMAGE

It is generally believed that proteolytic digestive enzymes in the venom cause hemorrhage, necrosis, myosis (excessive contraction of the pupil of the eye), and fatal shock. Hemorrhage caused by the Prairie rattlesnake *(Crotalus viridis viridis)* venom is illustrated in figure 1, and necrosis on human skin after bites by California rattlesnakes is shown in figures 2 and 3.

It was once believed that the seriousness of a snakebite was directly related to the degree of pain the stricken individual experienced. Scientific investigation has since shown that this is not always the case, however. It is well known that cobra venoms have high contents of neurotoxins (nerve poisons) which paralyze the nerve systems after snakebite. It is also known that rattlesnake venoms are rich in hemorrhagic and necrotic toxins which might be the one factor producing pain. The amount of this pain producing fraction varies from snake family to family as shown by the fact that a person bitten by one of the many cobras will experience little if any pain as compared to a person bitten by a rattlesnake.

Although physiological action of venom enzymes is relatively well known, their chemical properties have not been well investigated. Biological function of venom enzymes is believed to be an agent for "external digestion," i.e. the digestion of the prey. Our investigation of venoms of 60 snakes of different species and subspecies indicates that they are different from,

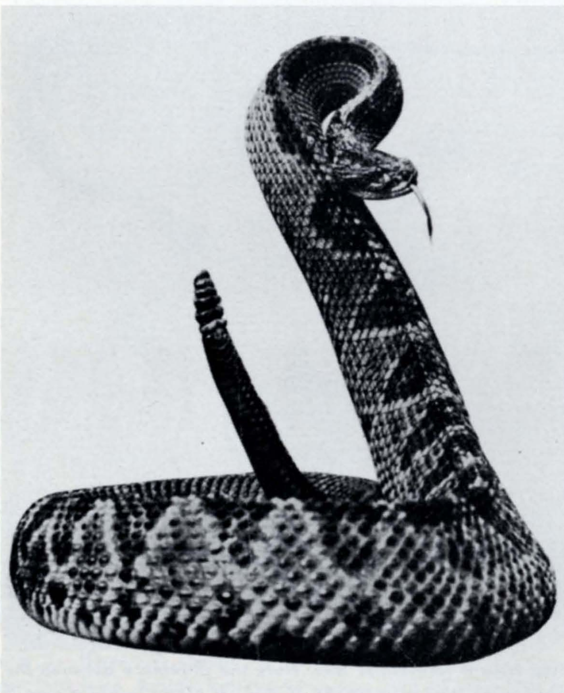

Figure 6a. Crotalid — a rattlesnake of Costa Rica.

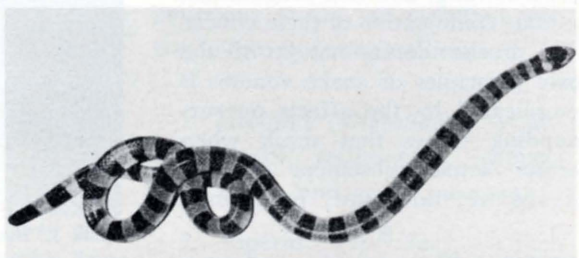

Figure 6b. Sea Snake — a banded snake of Formosa.

yet similar in action to, the normal internal digestive enzymes, trypsin and chymotrypsin. Trypsin and chymotrypsin are digestive enzymes secreted by the human pancreas and used for digestion of the proteins such as contained in eggs and meats.

Some venoms coagulate fibrinogen, one of the blood plasma components, to form a fibrin clot. Therefore, some venom proteolytic enzymes are also similar to thrombin, an important blood coagulation enzyme. Again, however, we have evidence that they are not identical to thrombin.

CHEMICAL DIFFERENCES

In our study of trypsin-like activity of snake venoms at Utah State University, we have found that there is a correlation of this enzyme distribution to the classification of poisonous snakes. We found that both crotalid and viperid venoms hydrolyzed (split into two fragments by water) chemical substances known to chemists as TAME and BAEE but none of the elapid and sea snakes hydrolyzed these substrates (substances acted upon by an enzyme). Venom from 32 species of crotalid, 9 species of viperid, 21 species of elapid, and 2 species of sea snakes were investigated.

This is an interesting finding because zoologists consider that crotalid and viperid are similar in morphology or bodily characteristics. Elapid and sea snakes also are considered similar to each other. Pharmacologists (those who study the properties and reactions of drugs) also have noticed that the venoms of the two families first named are mainly hemorrhagic and necrotic while venoms of the last two families are mainly neurotoxic. Chemists have found that cholinesterase (an enzyme present in nerve tissues which evidently plays a part in the transmission of nerve impulses) is present only in elapid and sea snake venoms and not in crotalid and viperid venoms.

VENOM RESEARCH

Three graduate students are working on peptidase (enzymes which digest simpler compounds formed by combination of amino acids) activities of snake venoms and have found that venom digestive activities of 12 different rattlesnake venoms are all identical. They used 40 peptides (compounds of amino acids) for the investigation. This same reaction held true whether venoms were obtained from the snakes of North America, Central America, or South America. Thus, it seems that within the same *genus,* venoms have identical digestive activities.

Their immediate objective is to identify the compounds that are present in snake venoms and how these venoms differ in composition in the different families, genera, species, and subspecies. To attain this objective, the researchers at USU, under the direction of Dr. Anthony T. Tu, assistant professor of biochemistry in the Department of Chemistry, are using several analytical methods. One such method is electrophoresis.

Electrophoresis is the technique used to separate compounds according to their electrical charge when influenced by a high voltage. In the past, inert supports (substances upon which the venom is placed) have included paper, starch, and various gels. One of the most recently introduced supports, however, are synthetic polyacetate strips.

The venom is placed on a polyacetate strip where it is examined by electrophoresis equipment. This is just one of the methods used to separate venoms into different components. Each component can be analyzed quantitatively after using a densitometer and a plainimeter.

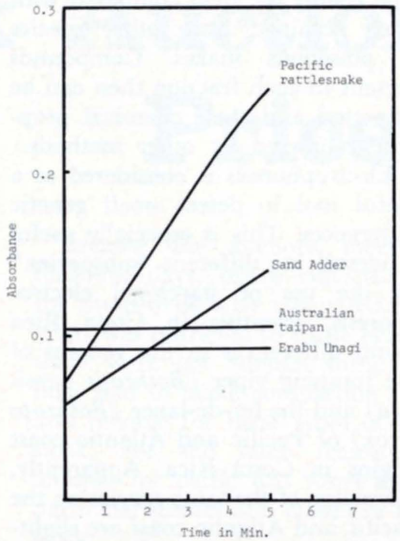

Figure 5. Proteolytic enzyme activities of the four families of snakes are illustrated using the synthetic substrate TAME. The pacific rattlesnake (Family crotalid) and the sand adder (Family viperid) show proteolytic activity while Australian taipan (Family elapid) and erabu unagi (Family sea snake) show no activity.

Figure 6c. Viperid — a Gaboon Viper of Africa.

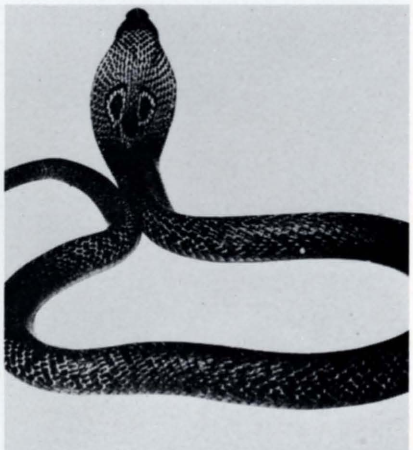

Figure 6d. Elapid — a hooded Cobra of India.

The results are then compared with those obtained from other species of poisonous snakes. Compounds present in each fraction then can be extracted and their chemical properties analyzed by other methods.

Electrophoresis is considered as a useful tool to detect small genetic differences. This is especially useful in identifying different "subspecies." By the use of starch-gel electrophoresis, scientists in Costa Rica found differences in the venoms of the jumping viper *(Bothrops numifera)* and the fer-de-lance *(Bothrops atrox)* of Pacific and Atlantic coast origins in Costa Rica. Apparently, the snakes of the same species on the Pacific and Atlantic coast are slightly different genetically. These small differences cannot be distinguished by studying their body forms and organs. This is a good example showing that chemical properties are a more sensitive indication of genetic identity than morphology. Our own polyacetate electrophoresis study has indicated that venoms from different cobras are quite different in chemical make up (figure 6)

FUTURE ACTIVITIES

Snake venoms contain a number of enzymes, the substrate specificities of which will be study extensively.

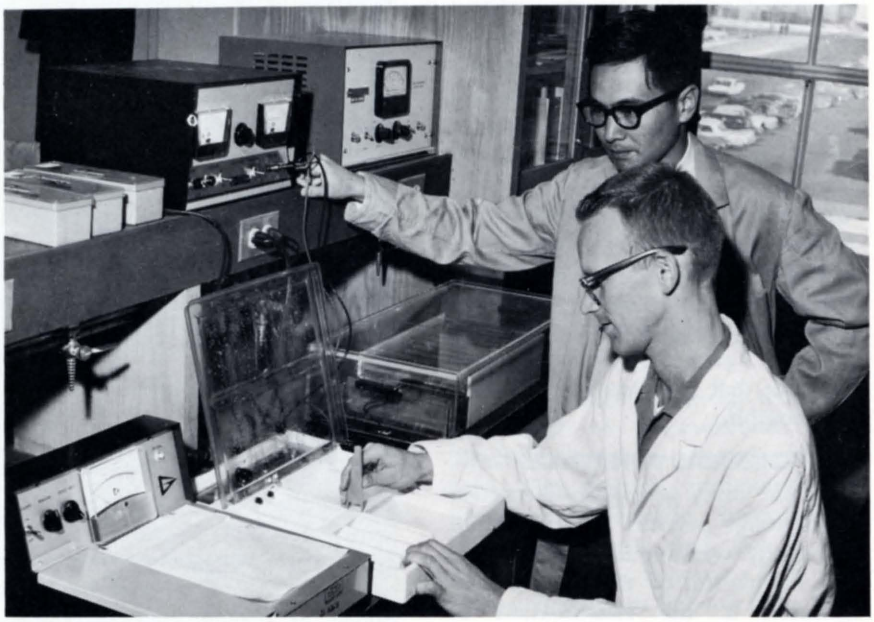

Figure 8. Dr. Tu and Paul M. Toom apply snake venom to a polyacetate strip in preparation for an electrophoretic separation.

Isolation of the toxic principles will be accomplished by using various methods such as ion-exchange and sephadex chromatography. Separated fractions will be investigated for their lethal, hemorrhagic, and necrotic toxicities and for the identification of the compounds present in each fraction.

The research group at USU plans to expand the work on the relationship of chemical properties of venoms and the taxonomy of venomous snakes. We have particular interest in the venoms of the *genus, Agkistrodon,* whose members are distributed in a wide area in North America, Southern Siberia, Japan, Formosa, China, South-East Asia, Burma, India, Pakistan, Eastern Europe and Central Asia. In North America, this *genus* includes the water moccasins, cottonmouths, and copperheads. It is well known that these snakes are of Asiatic origin coming from the Asian continent many geological eons ago when the North American Continent was connected to the Asiatic mainland at the present Bering Strait area. Therefore, it is of interest to know how the venoms of snakes of this genus differ chemically according to different present day geographical origins.

At present, we are investigating six species of U. S. origin, one from Japan, and one from Formosa. Our preliminary investigations have indicated that chemical properties of venoms of U. S. origins are very similar to one another. In the summer of 1966, Dr. Tu will go to

(Continued on page 31)

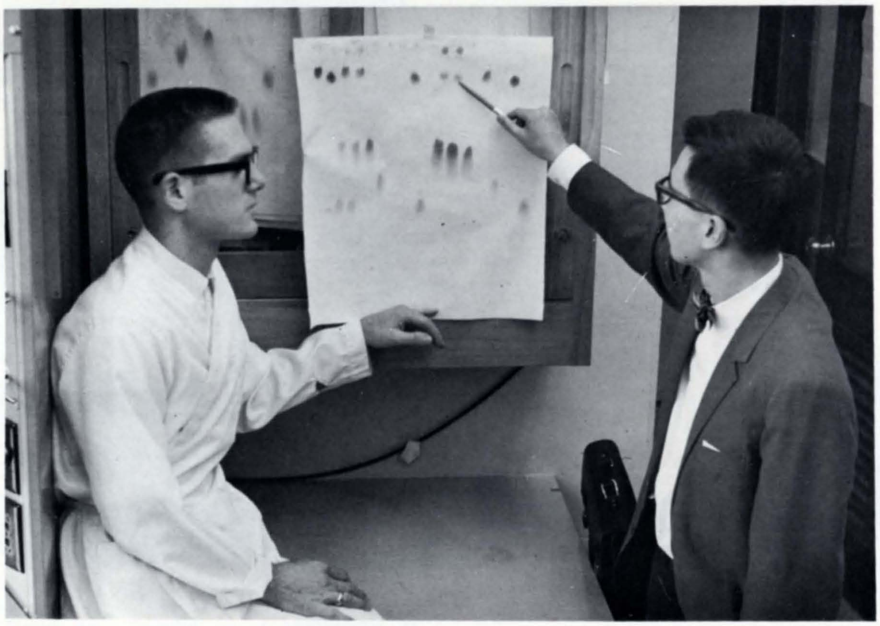

Figure 7. Dr. Tu and David S. Murdock examine a paper chromatogram showing hydrolysis or digestion of some peptides by snake venoms.

Utah Livestock Auction Prices

ELLIS W. LAMBORN and McNEIL GLENN

Significant numbers of livestock are marketed through livestock auctions in the State of Utah. The auction market is fairly close to the producer and, except for dealers that tour the country, the auction is the most convenient market generally available. More than one buyer is usually present at the auction and because of the nature of the bidding process prices are quickly established. Payment is made on a prompt basis.

There are 13 auctions at various locations in the state of Utah. Except for Kane County and the "four corners" area of San Juan, all areas of the state have reasonably easy access to a livestock auction market. One major auction is located at the public livestock yards at Ogden while another large one is located at the North Salt Lake livestock yards. These two auctions have traditionally been regarded as the central livestock markets in Utah.

ELLIS W. LAMBORN is an associate professor in the Department of Agricultural Economics. McNEIL GLENN is a former graduate assistant.

DETERMINING FACTS

To determine the facts about the pricing practices at livestock auctions, a number of selected auctions were visited on a regular weekly basis for 15 weeks during the summer of 1962 and another 15 weeks in the autumn of 1963. The person that visited the auctions graded the animals before they were sold and recorded the price received as well as other information that would affect the price received such as sex, age, and breed of each lot sold.

Collecting of this type of data makes two different comparisons possible. Price between grades of cattle at the same auction for the same day may be analyzed as well as price between auctions for the same grade of cattle.

Because the auctions meet on different days, prices collected for the same week were compared. The study was restricted to cattle because there were not enough sheep and hogs sold to make comparison valid and reliable for these types of livestock. For the same reason the analysis for cattle was restricted to particular grades and classes of livestock.

BETTER GRADE = BETTER PRICE

The better grades of livestock consistently sold for the best prices. For example, in 1962 good feeder cattle sold for about \$2.00 per hundredweight above the price of medium feeders (the grade used as a base) at all the auctions, table 1. Choice feeders at the various auctions sold from \$4.55 to \$5.29 per hundredweight, on the average, above medium feeders. In 1963 the price relationship between grades of feeders sold was the same as in 1962 but size of the differential

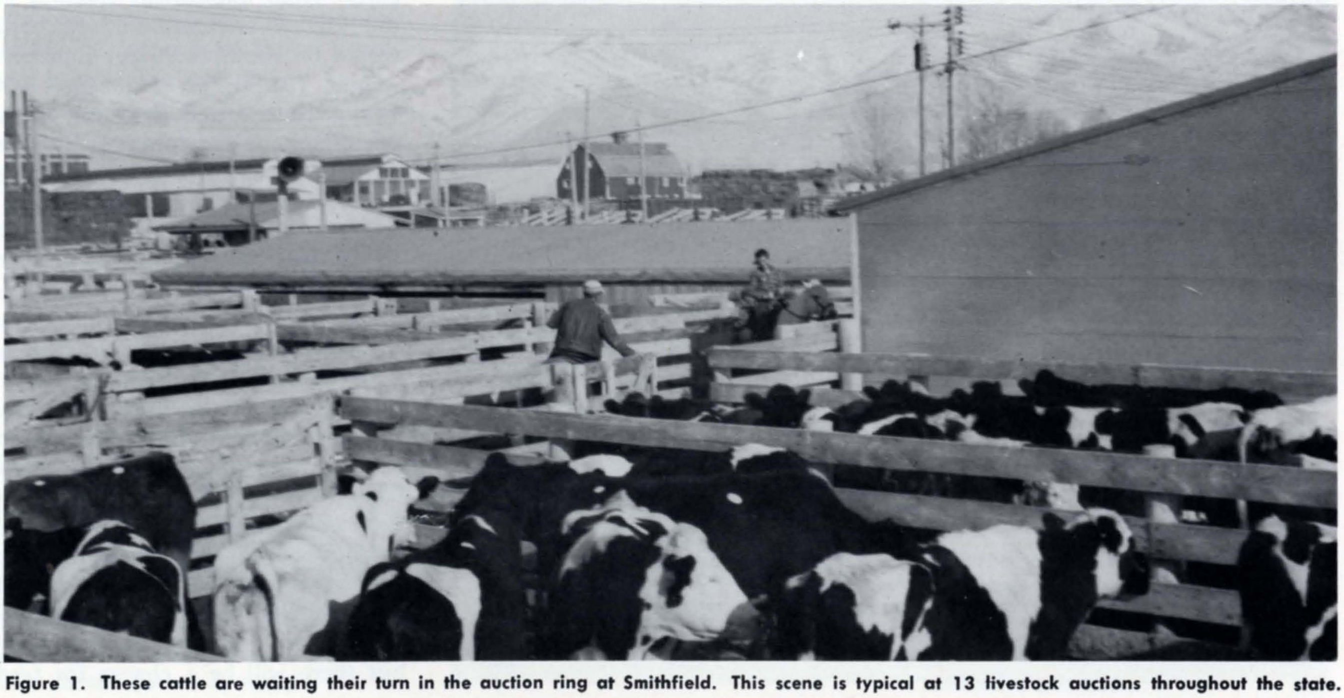

Figure 1. These cattle are waiting their turn in the auction ring at Smithfield. This scene is typical at 13 livestock auctions throughout the state.

between grades increased. Good feeders sold for about $3.00 per hundredweight above medium feeders with choice feeders selling for $5.00 to $6.00 per hundredweight above medium feeders, depending on the auction. The average price of medium feeders was practically the same at the four auctions studied, varying from $20.42 per hundred pounds at Richfield to $20.69 at Smithfield in 1962. While the average price was considerably lower in 1963 the variation among auctions was still very small.

The same general price relationship existed between canner, cutter and utility grade cows, table 2. These tables indicate that though the cattle sold at auctions were not officially graded, the buyers in essence graded the cattle as they were offered for sale and paid a premium for better quality cattle. This relationship was consistent for all classes of cattle where enough stock of the different grades was offered for sale to make valid comparisons.

MOVING COSTS

When prices for the same grade of cattle were compared among auctions, considerable variation was noted. The important question, however, is how much difference may there be between two auctions before movement of livestock takes place. If a significant movement of cattle between auctions is to take place, the price difference must be great enough to pay the cost of transferring the livestock and the price difference must be consistent and predictable. When livestock are purchased at one auction and moved to another for sale, costs are incurred for trucking, selling commission, shrinkage, and for feed (sometimes). Additional risks include physical damage or injury to the animals and price changes.

Let us consider two auctions — Smithfield and Ogden. Transportation costs from Smithfield to Ogden, a distance of 60 miles, total about 45 cents per hundred pounds. Selling commissions are usually charged on a per head basis. These commissions are slightly less than 50 cents when feeder stock is computed on a hundredweight basis. Shrinkage is more difficult to calculate. Different animals shrink at different rates depending upon a number of factors, not all of which are under the control of the owner. It is possible with a fill-back period, to regain most if not all of the weight lost. This means the incurring of a feed charge, however. In general, unless cattle can be left on feed 24 hours or more, it is not profitable to attempt fill-back. It is just as well to bear the shrinkage cost. And unless cattle have been off feed and water for at least 12 hours it is doubtful if fill-back would be worthwhile.

Assuming a shrink of 4 percent between the Smithfield and Ogden auction and a selling price for livestock of 25 cents per pound, the shrink will cost $1.00 per hundred pounds. Total cost then to move cattle from Smithfield auction to the Ogden auction and sell them would be about $1.95 per hundredweight ($1.00 for shrinkage, $.50 selling charge and $.45 for transportation). This does not include any allowance for risk — either on price or physical condition.

When the price at Ogden for cattle gets somewhat more than $1.95 above the Smithfield auction, dealers are encouraged to buy cattle at Smithfield and sell at Ogden. The reverse is also true. If Smithfield prices get at least $1.95 per hundred pounds above the Ogden auction market, cattle will move from Ogden to Smithfield for sale. Because the Smithfield auction is on Friday and the Ogden auction on Monday there will need to be an intervening feeding period. This will reduce the cost of shrinkage, but there will be a charge for feed

Table 1. Price differential among grades of feeder cattle at the same auction, Utah, 1962 and 1963

Year and auction	Price of medium feeders	Differential per hundredweight above medium grade feeders	
		Good	Choice
	dollars	dollars	dollars
1962			
Smithfield	20.69	1.99	5.29
Utah Valley	20.68	1.80	4.76
Richfield	20.42	2.09	4.55
Delta	20.48	2.30	4.77
1963			
Ogden	17.45	3.19	5.91
Smithfield	16.93	3.03	5.85
Utah Valley	17.28	2.71	5.59
Richfield	17.58	2.88	5.04
Delta	17.14	3.14	5.51

Table 2. Price differential among grades of cull cows at the same auction, Utah, 1962 and 1963

Year and auction	Price of canner cows	Differential per hundredweight above canner grade cows	
		Cutter	Utility
	dollars	dollars	dollars
1962			
Smithfield	12.68	1.77	3.81
Utah Valley	13.07	1.35	3.32
Richfield	12.72	1.56	3.25
Delta	12.24	1.77	4.06
1963			
Ogden	11.53	2.27	3.18
Smithfield	11.05	1.94	3.20
Utah Valley	10.98	2.22	3.20
Richfield	10.89	2.28	3.22
Delta	10.93	2.28	3.23

so the total cost will not be greatly different than that calculated above ($1.95 per hundred pounds)

PRICE FLUCTUATIONS

The price for choice feeder cattle at the Smithfield auction was higher than the Ogden auction by at least $1.95 per hundred pounds only 1 week during the period studied in 1963 (the Ogden auction was not included in the 1962 study). The price at Ogden was above the Smithfield price by at least $1.95 for choice feeders for 2 weeks during the 1963 study.

When good feeders are compared — Smithfield was above Ogden by $1.95 only 1 week during the 1963 study. This was not the same week that choice feeders were highest at Smithfield. The Ogden market was highest by $1.95 per hundred pounds 2 weeks during the period. Again, these were not the same 2 weeks that choice feeders were highest at Ogden.

Richfield is about 100 miles from the Utah Valley Auction at Spanish Fork. The Richfield Auction is held on Wednesday and the Utah Valley Auction is on Thursday, so the expected movement of livestock would be from Richfield to Utah Valley. It would cost about $2.25 per hundred pounds to move cattle from one auction and sell at the other (allowing for transportation shrinkage and selling charges).

During the 2-year study, there were 3 weeks when the price for choice feeders at Utah Valley Auction was higher than the price at Richfield Auction by more than $2.25 per hundred pounds. At no time, however, was the Richfield price above the price at Utah Valley by this amount. For good feeder cattle the price at Utah Valley was above the price at Richfield by at least $2.25 per hundred pounds only 1 week in 1962 and 1 week in 1963. These were not the same weeks when the differential was high enough to make the movement of choice feeder cattle profitable.

NO ACCURATE PREDICTIONS

It was impossible to predict in advance when the price difference between the two markets would be great enough to allow for the transfer of cattle from one market to the other.

All of the markets where cattle were likely to move from one market to another were compared and after making the proper adjustment for transportation, commission charges, and shrinkage, there were some weeks when the difference between the auctions would justify shipping cattle from one to the other. As has been stated before, these weeks, when the differences were great enough to justify the shipment of cattle, did not occur in any predictable pattern. Nor was the same market always highest.

Some dealers contend that it is possible to show a profit by buying "below the market at one auction and selling above the market at another auction." It is impossible to prove or disprove this statement. The observation may be made, however, that there were a few animals that did appear to sell below the "market for that class and grade for that day." There are at least two possible explanations: (1) The animal or animals were graded improperly and should have been graded lower, because the observer at the auction was instructed to grade the animals before the bidding started and then not to change the grade regardless of the final price at which the animal sold. (2) The animals sold below their actual worth.

In general, it may be said that there is some unexplained price variation between auctions. However, this price variation is not consistent from week to week, nor is it predictable.

Figure 2. Cache Valley livestock producers have a convenient market close by when the Smithfield Auction opens every Friday.

SNAKE VENOM

(Continued from page 28)

Thailand under a SEATO fellowship to study the venoms from Thailand snakes of the same *genus*. The results will be compared to those obtained from snakes of U. S., Japanese, and Formosan origins. Dr. Tu's findings will then be compared to USU research findings when he returns.

POTENTIAL

Although snakebites are a serious public health problem in many parts of the world, snakebite treatments depend exclusively on specific serum antivenom. Antivenoms are often ineffective for the bites of different species. In addition, if an individual is hypersensitive to horse serum, antivenom may not be used. The present lack of a practical non-serum treatment is largely because not enough detailed information concerning the chemical properties of snake venoms is available. The research being carried out at USU on snake venoms will provide some of the essential chemical information and will contribute to the long-range objective of developing a non-serum snakebite treatment.

Training Fruit Trees is Important

DAVID R. WALKER, J. LA MAR ANDERSON and ANSON B. CALL, JR.

(This is the first article in a series on pruning fruit trees).

Fruit growers are continually planting new trees for expansion and replacement, while home owners living in the city plant hundreds of trees in their backyards for shade and fruit. Many do not know the importance of training a tree the first year or two, and, as a result, have a poor-shaped, weak-crotched tree for many years thereafter.

The principle of training is to: (1) Provide a strong framework which will bear a large weight of fruit without breaking. (2) Provide open spaces between the laterals so that plenty of light can penetrate for proper tree growth, and provide complete spray penetration. (3) Provide for tree beauty and ease of picking. From the commercial point of view, keeping trees relatively small reduces the production cost per bushel, because the trees are easier to spray, thin, and harvest. A larger, better-colored fruit is also obtained from a well-pruned tree.

TRAIN EARLY

The most important time to start training a tree is the day it is planted.

Oftentimes, orchards have trees that have not received proper training. In some cases (figure 4), two or three limbs develop close to the ground and resemble trunks, with many side branches developing from them. (It is difficult to train an older tree of this type. If two limbs are removed, all of the side branches and a large portion of the tree are gone.) Hence, if training is not accomplished the first 2 or 3 years, it is often necessary to leave the tree as it is.

The height of the lower limbs can be influenced the day the tree is planted by the way it is pruned. Commercial growers like to have the first limb 18 to 24 inches from the ground. This allows tillage equipment to pass underneath the tree, yet it keeps the tree low and easy to pick. By removing part of the tree at planting time, it forces lower limbs to develop.

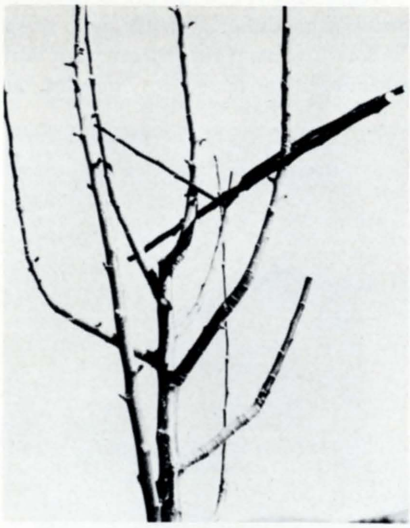

Figure 1. A young apple tree is trained to the modified leader system with sticks placed between the branches for the development of wide-angled crotches.

Trees should be planted in the early spring in cold climates, such as we have in Utah. They should be ordered the preceding fall while the desired varieties are still available, however. The purchase of vigorous 1-year-old trees rather than older trees is strongly recommended. Two-year-old trees may have been weak trees the preceding year and often do not come into bearing any earlier because the root system is reduced when digging. With 1-year-old trees, a person has a chance to develop a tree which produces fruit near the ground and develop strong lateral limbs which later may save the tree from severe limb splitting and tearing of the bark. Wide-angled crotches of 65° or more are strong and much less apt to split from heavy crops, snow or wind than narrow-angled crotches of 20° to 30°.

THE FIRST 2 YEARS

Training requires special attention throughout the first and second years. Growers may prune their trees at planting time but then not again until the following spring. This is unfortunate because during the second summer vigorous shoots, called water sprouts, grow and need to be removed. If these are removed early it conserves nutrients, water, etc., for the limbs which need to be encouraged. If a person walks through an orchard several times during the first 2 summers, taking just 1 minute per tree, he can shape

DAVID R. WALKER is a professor in the Department of Plant Science. J. LA MAR ANDERSON is an assistant professor in the Department of Plant Science. ANSON B. CALL, JR., is Extension Horticulturist.

his trees well, direct the growth of the tree, and save time and effort later. Summer pruning should not be done much later than late July or early August or the resultant growth stimulation may result in less winter hardiness.

Excessive pruning during the first few years should be avoided, however. This results in delayed fruiting; therefore only necessary cuts should be made on the young trees.

At the time of planting, the wire labels that indicate the variety should be removed. Otherwise, girdling may occur when growth starts.

YOUNG APPLE TREES

A 1-year-old apple tree is a long, straight shoot that resembles a willow with roots. This shoot may be 5 to 6 feet tall if it's a vigorous young tree, but it must be cut considerably to force limbs to grow lower down. If not cut, the buds 4 or 5 feet from the ground will develop into the first limbs and a stepladder will be needed to pick fruit from them. By pruning the tree at about 42 inches above the ground at planting the lower buds are forced out. Thus, the lower limbs form in the 18 to 24 inch region. If buds grow below this point, they should be eliminated. This can be done in May of the first year by merely pushing the early growth off with your thumb.

Such a drastic cut in the young tree stimulates the top four or five buds which start growing straight up. They take the place of the "leader" which was removed. This gives a "hat rack" effect, the many limbs growing upward, and is thought to be caused by hormone stimulus from the cut. In the early summer of the first year, after the growth is 5 or 6 inches long, it can be removed by topping an additional 5 to 7 inches from the original trunk. Removing these limbs stimulates the tree in some manner to provide wider angles on the remaining limbs.

Generally, these limbs are allowed to develop so that the leaves can provide the necessary carbohydrates for the tree. If the shoots appear quite vigorous the first summer, then the scaffold or main limbs can be selected.

Figure 2. An apple tree with four scaffold limbs and a number of spacer branches that have been cut back each year to form a dense center. This results in outward growth and wider angled crotches. Now that bearing has started, the center wood will be removed in another year.

SCAFFOLD LIMBS

It is desirable to space three or four scaffold limbs about 8 inches apart around the tree so that one is not directly above another (figure 3). This is called a modified leader system of training. If not enough good scaffold limbs are available the first year, others can be selected the next year.

In past years, it was a good horticultural practice to remove limbs that did not have wide angles and were growing close to the main limbs. Now, with a new method of training, they are maintained as "spacers." Such limbs are pruned back to half their size so they will not compete with the scaffold limbs. They form a lot of dense growth which forces the main limbs to develop wider angles. Limbs tend to grow straight up in many of the popular apple varieties. Each year, until the tree starts bearing, the spacers should be pruned heavily; only 4 to 6 inches of the new growth left. After 2 or 3 years using this type of pruning, many growing points develop into a dense, bush-type growth (figure 2). After the first or second year of bearing, the spacers can be cut off flush with the trunk.

During this time, very little pruning is done on the scaffold limbs. There are occasions, however, when a scaffold limb may become as large as or larger than the terminal limbs which develop into the trunk. In this case, side branches on the scaffold limb are removed so that the leader always remains the dominant portion of the tree.

STRONG CROTCHES

Another way to develop strong crotches is to place small sticks between the branches (figure 1). A heavy wire (1/8-inch diameter) cut to a point on either end also may be used. Insert one point into the limb, push the limb down to the desired position and insert the other point into the trunk. Limbs also can be tied down, by using wire or rope attached to stakes in the ground.

Staking trees is effective but it hampers the use of equipment.

Once the tree starts to bear, water sprouts may develop if the tree is fertilized or heavily pruned. The water sprouts should be thinned out (no closer than 3 inches apart) and pruned back to 3 or 4 inches. They may need pruning back to a few inches of new growth for 2 or 3 years before they develop into fruiting wood. This practice results in more fruit growing closer to the ground. With proper training practices, a standard-type apple tree can be picked from an 8-foot ladder. The whole tree gets plenty of light resulting in good colored fruit. Such an open tree also lends itself to adequate penetration of spray materials. Further details for pruning trees when they are older will be discussed in the next article of the series.

If there is a very poor selection of scaffold limbs or if the trunk was damaged the first year, it may be necessary to start over and practice trunk renewal. Trees requiring this treatment are cut 2 or 3 inches above the graft union in the spring of their second year. This is an extremely drastic cut but they develop very rapidly because there is a well-established root system feeding a very small portion above ground. This results in a vigorous tree the second year. Scaffold limbs then are selected as usual, and after a period of 4 or 5 years these trees are the same size as the others, even though the trunk started a year later.

FILLER TREES

Training "filler trees" is somewhat different than "permanent trees." Filler trees are planted close to permanent trees and are removed when crowded conditions develop. The advantage of this, of course, is obtaining some fruit in the early years before the permanent trees are producing a large volume. These trees may be planted as close as 8 to 10 feet apart with 20 feet between rows. After 4 or 5 years of bearing, the fillers are removed leaving the trees 18 to 20 feet apart in the row. Filler trees should not be pruned as heavily as permanent trees; they will develop into bigger trees sooner and be able to produce more. The structural framework of this type of tree may be weaker, but it is not as important because breakage is not as apt to occur on a young tree bearing a relatively small crop. When the filler trees start crowding the other trees, they should be pruned heavily on the sides next to permanent trees to avoid competition.

Dwarf apple trees often have flowers the second or third year while the tree is still small. To develop a good-sized, sturdy tree with adequate bearing surface for future years as soon as possible, remove the flowers until the fourth year so that the growth will go into tree development rather than fruit production. Of course, some dwarf apple trees are one-eighth the size of a normal tree. If such is the case and the objective is to maintain a small tree in a backyard, then it is all right to allow early fruiting.

If the area is subject to severe winter winds, it may be necessary to stake or support the tree to prevent it from blowing over. This treatment should be maintained until the roots develop sufficiently to withstand the wind. With strong winds, the growth of limbs are greatly influenced. Scaffold limbs should not be trained directly into the wind because they will be blown up against the trunk, causing a narrow angle. The main leader should be headed into the wind. After a period of time it will probably be blown to the downwind side of the tree.

PEARS, APRICOTS AND SOUR CHERRIES

Pears, apricots and sour cherry trees are pruned similar to apples, except spacer limbs are not left. Pears have a much greater tendency to grow straight up. This makes it much more difficult to develop wide-angle crotches than with apple trees. More pear limbs are tied down to spread the limbs away from the trunk. In training your pears and apricots, as with apple trees, the less pruning the better, for a

Figure 3. An apple tree with poor crotch structure. The scaffold limbs developed at the same location on the trunk and they have too many branches growing on them.

strong tree. If pears are pruned heavily, they are more susceptible to fire blight, a bacterial disease.

SWEET CHERRIES

Sweet cherry trees tend to develop long vertical upper limbs similar to pears, resulting in a leggy-type growth with few laterals. Training the first 2 years is especially important with sweet cherry trees. These trees are usually headed at 24 to 30 inches when planted unless the tree is very weak, in which case it may be headed as low as 12 inches. Heading above 30 inches often produces branching at the top and few limbs develop lower down. During the first and second years three permanent leaders may be selected which may be evenly spaced 12 to 18 inches apart around the tree. A few branches between these leaders may be left but should not be allowed to reach the size of or compete with the scaffolds. Pinching off terminal buds during the growing season is very important in forcing lateral branches on the tree. When the scaffold limbs reach 30 inches cut off the tip 5 or 6 inches to an outside bud; and the other branches when they are 20 inches long. This retards too vigorous growth and results in more side branching and fruiting wood closer to the ground. If just the tip is removed rather than the 5 or 6 inches suggested, narrower angles result which often break later. This practice is followed each time an additional 20 or 30 inches of growth has developed.

Training sweet cherry trees requires a longer period of time than other fruit trees. The pinching and heading back operation may continue for 4 to 6 years and must be done at least two times each summer.

Figure 4. A young apple tree with four trunks developing. This causes a very dense and weak structured tree.

PEACH TREES

Peach trees are generally pruned using an open-center system of training rather than a modified leader system as recommended for the other fruit trees. With an open-center system, three to four scaffold branches are developed much closer together than with the other trees. At planting cut the main shoot about 30 inches from the ground. If you are desirous of having most of the laterals develop from the same level, cut it 20 inches from the ground, whereas if you prefer having space between the laterals the trees may be cut at 30 inches. If it is a vigorous tree, three or four scaffold limbs can be selected. Cut them back to eight or ten buds each and eliminate the rest. If the tree is not very vigorous, more buds should be cut off the laterals leaving as few as one or two buds per lateral. If buds develop lower than the desired height for the lowest branch (15 or 18 inches), push them off. This severe pruning at the time of planting allows the root system to develop and vigorous shoots to grow from the lateral buds. With weaker trees, scaffold limbs are not selected until mid summer of the first year. A little pruning the first 2 summers may save heavy cutting later. This completes the training. The third year and fourth year, remove only the amount of wood necessary to maintain the desired structure and shape.

UTAH CHRISTMAS TREE SALES 1965

JOHN D. HUNT
CLYN S. BISHOP

It was a "banner" year, in 1965, for Utah Christmas tree retailers. Compared to 1964, total Christmas tree sales increased, surpluses were down, and Utah lands provided a greater portion of the tree supply. Forty-nine retail lots, sampled in 26 Utah communities, sold approximately 14 percent more trees than in 1964. These same lots recorded only a 9.5 percent surplus as compared to more than 20 percent the preceding year.

SPECIES OF CHRISTMAS TREES

Pinyon pine regained its position as the most popular tree on the Utah retail lots after being displaced by Douglas-fir in 1963 (table 1). However, these two species, which have made up from 50 to 75 percent of the total number in past years, continued to decline. The spruces and true firs showed marked increases, while the pines remained relatively stable. National trends indicate that the pines will gain in popularity and eventually become the most numerous tree on retail lots. This belief is held because more Christmas trees are being grown on plantations; and pines are favored for this type of production. Generally speaking, the pines grow more rapidly and are easily treated for quality form.

Since surveys of the Utah Christmas tree retail market were begun in 1960, surpluses have continued to be high in the even years and low in the odd years. Although 1965 surpluses were lower than those of 1962 and 1964, they were considerably higher than in 1963. In 1963, the stock of trees on retail lots came very close to meeting demand. At the end of the sales period, only between 1 percent and 2 percent of the trees remained unsold.

CHRISTMAS TREE SOURCES

With the exception of Idaho and Canada, all regions which usually export trees into Utah contributed a considerably smaller percentage to the Utah market (table 2). Utah, after taking a major slump in 1963, bounced back to take the lead and supplied nearly one-half of the

JOHN D. HUNT is an assistant professor in the Department of Forest Science. CLYN S. BISHOP is a district forester with the Utah Department of Forestry and Fire Control stationed at Utah State University.

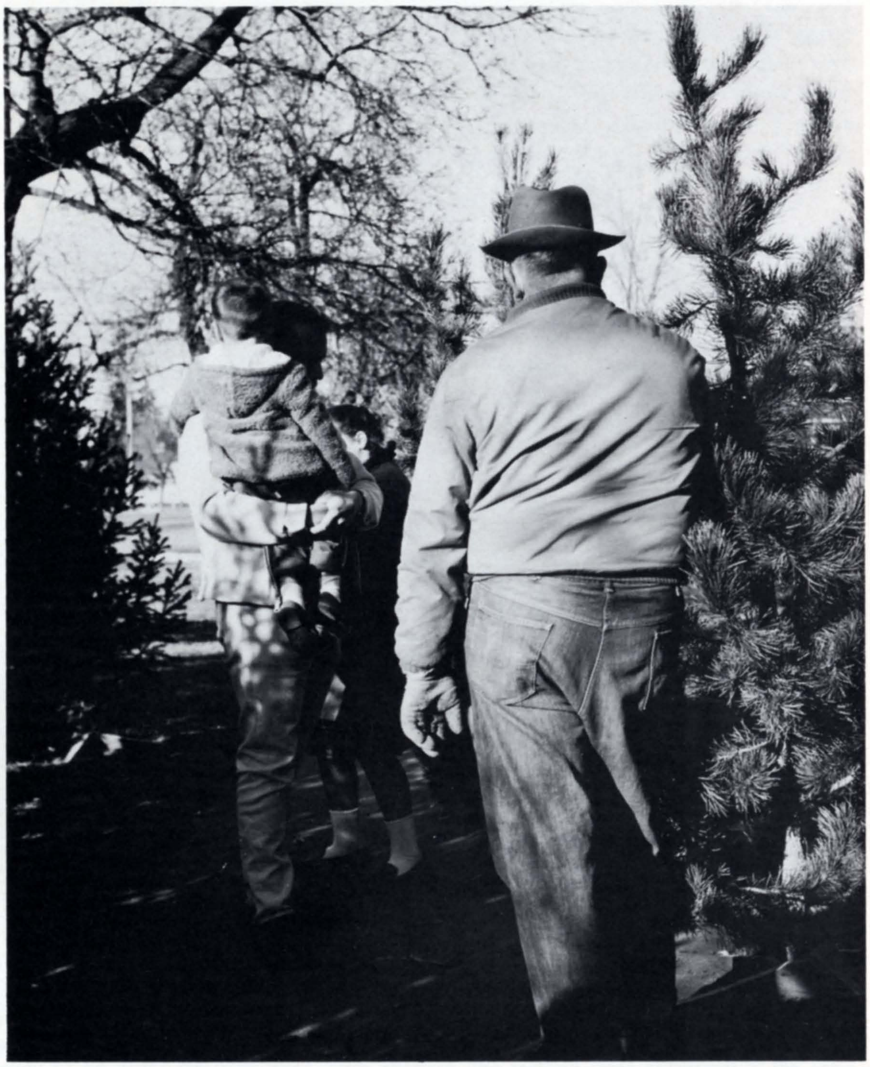

Figure 1. The use of the evergreen tree is a Christmas tradition of most Americans. Purchase of the "tannenbaum" signals the beginning of the Yuletide season.

trees available to Utah consumers. Nearly all of the pinyon pine, white fir, and subalpine fir, which comprised the major portion of the supply, were harvested from Utah forests. The number of trees from Montana, which has been the largest in past years, continued to decline. Since 1961, there has been a downward trend in the number of Montana trees on Utah retail lots.

WHOLESALE AND RETAIL PRICES

While the range of both wholesale and retail prices seemed to increase in 1965 as compared to past years, there tended to be a slight reduction in prices (table 3). Douglas-fir, nearly all imported from Montana, was the only species where a slight rise in both wholesale and retail prices was noticed. This rise could possibly be attributed to the rising cost of transportation and the increase in quality of these trees. A major industry in Montana, Christmas tree exporting has been decreasing in recent years. One factor believed to be causing this decline has been poor quality and, consequently, more emphasis has recently been given to the production of superior trees.

The general reduction in the prices of other species may be partially the result of two major changes in the 1965 Christmas tree market: (1) Since far more trees came from Utah in 1965, the cost of transporting them to market was probably less than for trees coming from out of state. (2) More supermarkets, gasoline stations, department stores, and other businesses used Christmas trees for lead items. While some of these retail outlets offered a Christmas tree free with a major purchase of their goods, most offered a tree at an extremely low price in an attempt to get the customer into their place of business.

Scotch pine, a newcomer to the Utah retail market and a species grown exclusively on plantations, was the highest priced tree. Scotch pine was followed closely by ponderosa pine and spruce, which have been the most highly priced trees in past years.

Table 1. Species of Christmas trees in Utah retail lots, 1960, 1961, 1963, and 1965

	Percent			
Species	1960	1961	1963	1965
Pinyon pine	56.0	38.2	29.7	25.6
Douglas-fir	20.0	35.0	30.7	19.1
Spruce	12.0	9.1	9.3	11.0
White fir	3.0	2.1	1.9	11.7
Subalpine, balsam and grand fir	5.2	10.8	20.7	25.3
Ponderosa pine	2.0	2.1	5.6	4.3
Lodgepole pine	1.8	2.7	1.9	2.4
Scotch pine	—	—	0.2	0.6
Total	100.0	100.0	100.0	100.0

Table 2. Source of Utah's Christmas trees, 1960, 1961, 1963, and 1965

Source	Percent	Percent	Percent	Percent
Utah	33.0	39.5	22.7	46.8
Montana	38.8	45.8	35.9	34.3
Nevada	15.5	4.0	15.1	7.6
Idaho	8.3	2.3	2.6	4.1
Colorado	2.5	1.1	10.5	2.1
Wyoming	1.2	0.3	5.5	2.2
Washington	0.7	6.0	4.0	1.7
Arizona	—	0.9	2.1	—
New Mexico	—	0.1	0.7	—
Canada	—	—	0.9	1.2
	100.0	100.0	100.0	100.0

Figure 2. This tree farmer has his crop growing right in the back yard. As more Utahns establish Christmas tree plantations the percentage of Utah trees for the Utah market will increase.

FLOCKED TREES AND NOVELTY ITEMS

Fewer painted trees were available to Utah Christmas tree buyers in 1965 as the flocked tree gained in popularity. With the advent of the home tree-flocking kit, the price of commercially flocked trees seemed to decrease somewhat in 1965. Although, in some instances, flocked trees were relatively high in price, the majority of these trees for home use ranged from $5 to $15. Ponderosa pine seemed to be the most popular flocked tree and sold for the highest price.

More Christmas tree retailers sold novelty items than in the past. Evergreen boughs were sold from $.25 to $1 per bundle of about one-half dozen branches. In nearly all cases, the sale of boughs proved profitable to the retailers since they were trimmed from the base of the trees in order to attach the stand. In the past, these boughs have either been given to the Christmas tree purchaser or discarded. Some retailers made wreaths from the boughs and sold them for prices ranging from $1.50 to $5.50. Pine cones and holly were also for sale at some Utah Christmas tree lots.

THE FUTURE

Utah landowners may well continue to supply a greater portion of the Christmas trees for Utah retail lots. Although there seems to be a dwindling supply of quality Utah pinyon pine, as more landowners begin to establish Christmas tree plantations, the percentage of Utah trees for the Utah market will increase.

The quality of Christmas trees appearing in Utah will improve and will be accompanied by increasing prices. Here again, the trend toward plantation-grown trees will affect these factors.

The artificial tree, having had considerable impact on natural tree sales in the past, will continue to make inroads into sales, but to a lesser degree.

Finally, it is safe to say that the use of the evergeen tree will continue to be a Christmas tradition of most Americans and will serve as the focal point of the family Yuletide celebration.

Table 3. Wholesale and retail price ranges for Christmas trees in Utah, 1965

Species	Wholesale range		Retail range	
	Low	High	Low	High
Pinyon pine	$0.85	$5.00	$2.00	$ 8.00
Douglas-fir	0.20	4.00	2.00	7.00
Spruce	1.00	5.00	4.00	10.00
White fir	.20	4.00	2.00	8.50
Subalpine, balsam, and grand fir	.15	4.00	1.50	8.50
Ponderosa pine	2.00	4.00	3.00	10.00
Lodgepole pine	.10	3.00	3.00	5.00
Scotch pine	.60	4.00	3.00	10.00

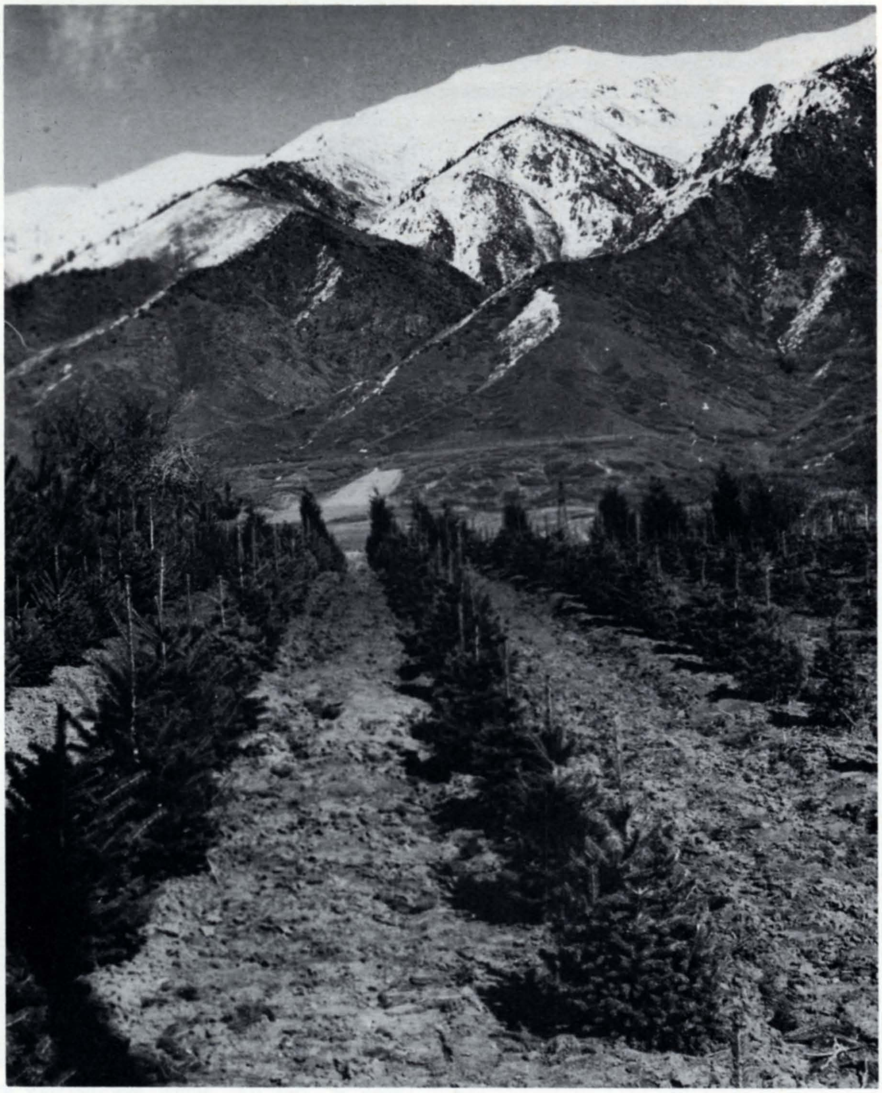

Figure 3. This is the back yard view, showing an unusual money making crop. Christmas tree growing is a new profit industry for some Utah landowners.

Peach Varieties for Utah's Dixie

J. LA MAR ANDERSON, ANSON B. CALL, JR., and DON HUBER

Peaches differ from apples in their response to high summer temperature. Whereas apples tend to sunburn and develop poor color and quality at warmer temperatures, peaches color well and often develop better flavor under a warmer climate than in a cool one. They have little tendency to sunburn. The interval between blossom time and harvest of peaches and other stone fruits is stikingly influenced by temperature; the higher the mean maximum temperature, up to about 85° F, the earlier the fruit ripens.

A comparison of temperatures recorded during the 15-year period from 1950 to 1964 at LaVerkin, in the center of Washington county's fruit-producing area, and at Brigham City, noted for its northern Utah peaches, shows significant difference in climate during the peach-ripening season. LaVerkin boasts an average frost-free growing season of 179.5 days (April 30 to October 26) while the frost-free season of Brigham City is 162.5 days (May 1 .to October 10).

•

J. LA MAR ANDERSON is an assistant professor of horticulture in the Department of Plant Science. ANSON B. CALL, JR., is Extension Horticulturist. DON A. HUBER is Extension Agent for Washington County.

CLIMATE DIFFERENCE

To appreciate more fully the difference in climate between the two peach production areas, one need only compare the heat summation during the growing season. Heat summation, as used here, means the sum of the mean daily temperature above 50° F. For example, if the mean for a day is 70° F, the summation is 20 degree-days, and if the mean for June is 65° F the summation is 450 degree-days (15 degrees times 30 days). The heat summation for LaVerkin averaged 4093 degree-days above 50° F over the 15-year period whereas Brigham City averaged 3015 degree-days. Consequently, the same peach variety may bloom 2 weeks earlier in Washington County than in Box Elder County and yet ripen as much as 4 weeks earlier.

Washington County peach growers could capitalize on their climate by concentrating their production in early-ripening peach varieties. These could be marketed in northern areas before the same peach varieties are ripe in the north. Redhaven, the earliest peach variety now grown in Utah in commercial quantities, has ripened July 21, 1964 and July 15, 1965, in Washington County. However, in the Santa Clara area of Washington County, Redhaven ripened even earlier. It usually ripens the week of August 7-14 in Box Elder County.

Southern growers would also find

Figure 1. The areas outlined in green on this sketch map indicate possible peach growing territory when the Dixie Project is complete.

little competition on the very late market. The United States Department of Agriculture recently released a new late peach named Summerset that ripens in mid-October, which has been experimentally tested in Washington County. Other good-quality peach varieties such as Merrill Fiesta and Merrill Pageant are grown in our southern climate and are harvested as late as October 26th. These varieties would not ripen in northern Utah nor are there any other varieties ripening this late in the season in northern Utah.

THE DIXIE PROJECT

Under the proposed Dixie Project, two reservoirs will be created by the Virgin and Lower Gunlock Dams. Also included in the project will be a 26-mile-long canal to deliver water to currently nonirrigated land. All together, irrigation water for 11,615 acres of land not yet developed and supplemental water to 9,445 acres of land already in production will be made available.

Better than half of the undeveloped land that would receive water once these proposed dams are built would be ideal for fruit production. Therefore, there is a good potential for increasing the peach acreage and production in Washington County in the near future.

NEW PEACH VARIETIES

Peach variety recommendations have undergone almost a complete revision in the past 20 years. Many of today's varieties were never heard of in 1955 and many will be "has-beens" by 1975.

Consumer tastes and habits have changed. Home canning of a year's supply of fruit, while still important in Utah, is on the decline. Buyers today demand a highly colored, good-quality, yellow freestone peach of large size and good shelf life. Old favorites such as the Elberta are falling by the wayside making way for the highly colored varieties desired by the modern homemaker.

Several improved peach varieties are being introduced each year. The individual fruit grower is confronted with the necessity to produce peaches that will compete on the ever-improving quality market. At the same time, he cannot afford to experiment with each new variety that is developed.

VARIETIES FOR UTAH'S DIXIE

Variety recommendations made for northern Utah are not necessarily valid for Washington County and would not include the late ripening varieties. In 1958 the Utah State Agricultural Experiment Station and the Extension Service in cooperation with Washington County established an experimental fruit planting at Hurricane, Utah. Recently developed varieties of apples, peaches, plumbs, apricots and grapes are being evaluated under the southern environmental conditions and compared to established varieties.

The project is unique in that it is a cooperative study involving Washington County, which rents that part of the Lawrence Hinton farm upon which the orchard is growing; the Experiment Station, which directs the research; and the Extension Service, which supervises the operation of the project through the Washington County Agent and the Extension Horticulturist. Local interest in this study is high. Growers visit the orchard several times each year individually and to attend field days to observe the fruit as well as to see demonstrations of orchard management practices.

The peach varieties have been in production for 5 years now. The following early- and late-bearing varieties are recommended for commercial production in Washington County. These are given emphasis because it is felt that peaches ripening during these seasons have the greatest economic potential in shipment beyond the local market.

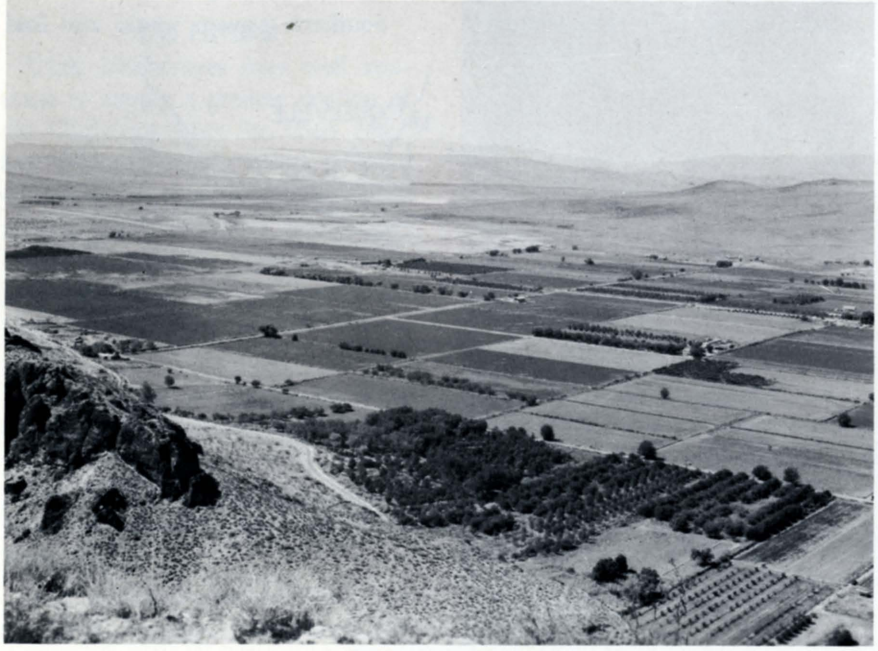

Figure 2. This area south of Hurricane, Utah will be an excellent peach producing site upon completion of the proposed Dixie Project.

EARLY PEACH VARIETIES

Early peach varieties in general tend to be small unless thinned heavily early in the season. Early varieties also tend to produce more split pits than the later-ripening varieties.

The early peach variety with the largest acreage in Washington County is Redhavan. This peach ripens about July 20 at the Hurricane Experimental Fruit Variety Trial. These plots are located in an area in which the fruit ripens about one week later than other production areas in the county. The ripening date given hereafter will be those of the experimental plantings.

CARDINAL. This variety is one of the best very early peaches with commercial quality, ripening about June 30. It is a yellow-fleshed, semi-freestone peach with an attractive red skin color. Fruits are firm with a slightly stringy to medium texture and good flavor.

SUNHAVEN. This yellow-fleshed, semi-freestone variety ripens about July 10. It is a firm, good-flavored peach that is resistant to browning and has a skin color similar to Redhaven but not so well colored.

CORONET. This yellow-fleshed, nearly round peach ripens about July 18. It is smooth textured, has a good mild flavor, but tends to soften a little at the apex. It is essentially a freestone when fully ripe.

REDHAVEN. This variety is a yellow-fleshed, fine-textured, semi-freestone peach, becoming nearly freestone when tree ripened, and has an attractive almost over-all bright red color. It has high dessert quality and has been very productive. It ripens about July 20. Redhaven has a non-browning flesh characteristic and is well adapted for freezing.

SUNBRIGHT. This variety has been tested several years as Utah 157. It is a highly colored, yellow-fleshed peach that ripens about July 30. It is firm fleshed with good flavor and texture.

LATE PEACH VARIETIES

The following varieties ripen after the peach season in northern Utah has ended. These varieties provide a commercial potential for shipment to northern Utah as well as extending the local market season.

SUMMERSET. This new variety ripens at the Hurricane orchard about October 3. The fruit is large, round, and freestone with light fuzz on the skin. The flesh is yellow, firm but melting, and of good texture and flavor. About one-third of the skin surface has a bright red flesh.

MERRILL FIESTA. This large yellow-fleshed peach ripens about October 20. It is firm fleshed with a good texture and very good flavor. The skin is more highly colored than Summerset. The peach is a good shipper.

MERRILL PAGEANT. This peach is similar to Merrill Fiesta in all respects except that it ripens 2 or 3 days later.

Figure 3. Don A. Huber, Washington County Extension Agent, and Anson B. Call, Jr., Extension Horticulturist, inspect a lug of freshly picked Merrill Splendor peaches.

Figure 4. Three peaches get together in Utah's Dixie. The young lady seems anxious to proceed with the taste test.

Table 1. A summary of good and promising varieties and their ripening dates at the Hurricane planting. All are yellow-fleshed varieties

Variety	Ripening date	Recommendations
Cardinal	June 30	Perhaps the best early peach variety
June Gold	July 1	Promising new variety
Stark Earliglo	July 1	Promising new variety
Sunhaven	July 10	Good early variety
Coronet	July 20	Good Variety
Redhaven	July 20	Standard early variety, good shipper
Red Top	July 28	Very promising new variety
Sunbright (Utah 157)	July 30	Very promising new variety
Richhaven	August 5	One of the best varieties under evaluation
Washington	August 5	Promising new variety
Sunhigh	August 8	Good shipper, lemon shaped
Red Globe	August 12	Very promising variety, good shipper
Regina	August 20	Promising new variety
Suncrest	August 20	Promising new variety
Early Elberta	August 25	One of Utah's favorites
Blake	August 30	Good variety, good shipper
Elberta	August 30	
Redskin	September 1	Replacing Elberta in many areas
Jefferson	September 1	Promising new variety
Rio Oso Gem	September 10	Old variety
Merrill Splendor	September 10	Good, superior to Rio Oso Gem
Summerset	October 3	Promising new variety
Merrill Fiesta	October 20	Very good late peach
Merrill Pageant	October 28	Very good late peach

Medics Operate on Unborn Lambs

A method of correcting birth defects in unborn humans could be one development of research by a team of scientists from Johns Hopkins University School of Medicine, the Armed Forces Institute of Pathology, and the U. S. Department of Agriculture.

Working at John Hopkins University, the scientists have redelivered lamb fetuses several times in various stages of development, treated them medically or surgically, and returned them to the uterus — with no apparent harm to the fetus. Lambs have then been born in a normal manner at the normal time.

Quite early in the studies, the researchers challenged the longheld notion that immune reactions, such as the rejection of foreign skin tissue, takes place only after birth.

They found that lamb fetuses do reject skin grafts from other sheep — adults or other fetuses — after only 80 days of development in the womb. The fetus does not reject at any time a skin graft taken from another part of its own body or grafts from other sheep made before 80 days of development.

Their finding raises a new question, however: If, for most of its development, a fetus rejects transplanted tissues from its mother's body, why don't the placenta (fetal tissue) and the mother's tissue to which it is attached reject each other? They are eager to discover the answer, which may help find ways to make the human body accept "spare parts" when the originals wear out.

In their operations thus far, the scientists have had exceptional recovery of lamb fetuses after rather extensive operations. Skin grafts — if they take — heal without scars. And the only trace of a suture is the remaining strands of thread.

Animal geneticists and wool specialists have confirmed that the genetic mechanism for wool growth is controlled by the skin on which it grows. In one phase of the research, a patch of skin was transplanted from the thigh of a fetus to its side. After the lamb was born, it had a small island of coarse thigh wool growing in a sea of typically fine side wool.

Once they understand this genetic mechanism better, geneticists may be able to develop sheep that have more desirable wool on all parts of their bodies.

New Tomato Resistant To Curly Top

A tomato line with the highest level of resistance to curly top disease of any variety or breeding line tested to date has been developed.

The Utah Agricultural Experiment Station and USDA's Agricultural Research Service developed the new line, designated CVF4. All available seed has been distributed to plant breeders.

Plant breeders may be able to use CVF4 to develop commercial tomato varieties, thereby opening additional areas of the West for commercial production. In these areas, curly top disease is so severe that tomato production is now risked on thousands of acres otherwise well suited to the crop.

Although CVF4 is not suitable for commercial use, promising lines are resulting from crossing it with commercial varieties.

Curly top, a virus disease spread by beet leafhoppers, occurs sporadically in the Western States. Since there is no satisfactory artificial control method known, developing resistant varieties appears to be the only way to prevent losses.

Corn Starch Used for Insulation Foams

Polyethers can be made from corn starch that are comparable in cost and quality with polyethers now used in manufacturing light-weight foams for insulation, the U. S. Department of Agriculture reports.

Rigid urethane foams are used to insulate refrigerators and freezers, refrigerated trucks and tank cars, and buildings. Commercial production is expected to reach 65 million pounds this year and 100 million pounds by 1968.

Archer Daniels Midland Company of Minneapolis, working under contract with USDA's Agricultural Research Service, has conducted studies that show that starch-based polyethers can be made for about 15 cents per pound in a plant producing 10 million pounds a year. This volume of polyethers would use the starch from 100,000 bushels of corn.

Scaling up a process developed by ARS, the contract scientists made starch-based polyethers in experimental lots as large as 1,300 pounds. They then converted the polyethers to dry, rigid foams at rates of 45 to 50 pounds per minute. The resulting foams have strength, flame resistance, and other properties comparable to those of commercially available urethane foams.

Starch-based polyethers were first made and converted to foams on a laboratory scale 3 years ago by the Northern Utilization Research Laboratory, Peoria, Ill., as part of a broad effort by ARS to find new uses for farm products.

The Peoria chemists made the polyethers by (1) reacting starch with ethylene glycol (commonly used as an antifreeze) to make glycosides and (2) reacting the glycosides with propylene oxide to make the polyethers.

SCIENTISTS DEVELOP MINIATURE HOGS FOR DRUG TESTS

Miniature white hogs are being developed by scientists of the U. S. Department of Agriculture and the Food and Drug Administration for use as research animals.

Besides aiding FDA's drug testing program, the minature animals — about a third of the weight of normal hogs — may help USDA learn more about hog nutrition, physiology, and biochemistry. And they offer some farmers a way to increase income by raising research animals for investigators at many research, testing, and assaying laboratories throughout the United States.

Why hogs as test animals? Dr. Francis L. Earl, FDA veterinary toxicologist, explains that hogs are physiologically much like humans — subject to many of the same maladies. They have about the same food requirements, digest food in much the same way — even suffer from peptic ulcers. And a hog's heart and major blood vessels also resemble those of humans.

Small hogs also require smaller doses of costly experimental drugs, are less expensive to house, and are easier to handle.

Jack C. Taylor, USDA geneticist, is in charge of developing the miniature hog herd, which was started 2 years ago at Beltsville, Maryland.

Penalty for private use to avoid payment of postage $300

Utah State University
Agricultural Experiment Station
Logan, Utah

Wynne Thorne
Director

Form U. Q. Permit 1142

POSTMASTER: Please return if unclaimed

USDA DEVELOPS SALINITY GAUGE

A small instrument that will determine salinity buildup in a plant's root zone without disturbing either soil or roots has been developed by the USDA.

Buildup of soil salinity is already — or could become — a major problem in most of the nearly 32 million acres of irrigated farmland in the Western States. Limited rainfall in this region reduces the natural leaching of salts from the soil. Instead, these salts must be removed by applying irrigation water in excess of that evaporated from the plant and the soil.

The new salinity sensor checks soil salinity by measuring the electrical conductivity of the soil moisture. When they become available, sensors can be permanently installed below plow depth at different locations in fields to give continuous indications of soil salinity fluctuations. It is now being used as a research tool, but it also has practical value. For example, an engineer in an irrigation district could use sensors to determine when to apply leaching or other management practices to reduce salinity.

CONTRIBUTIONS TO RESEARCH

Esso Company	$5,000 for studies of irrigation canals and reservoir linings
Nutrition Foundation	$4,930 for studies of lipid and nicotinic acid interrelationships in human blood fractions
Corn Products Company	$4,000 for studies of serum alpha-to-copherol levels in 40- to 65-year-old adults on self-selected diets with and without an increased level of polyunsaturated fat
Cudahy Packing Company	$2,500 for studies of the manufacture of pizza cheese from reconstituted milk
Merck and Company, Inc.	$2,000 for studies of trichomoniasis, coccidiosis, and other protozoan diseases of livestock in Utah
American Gilsonite Company	$1,996 for studies of plant-growth promoting properties of pulverized gilsonite and pulverized asphaltine
Squibb Institute for Medical Research	$1,890 for drugs to aid in brisket disease research
Ogden Grain Exchange	$1,200 for studies of improvement of fall-sown wheat through breeding
Diamond Alkali Company	$750 for studies of the effects of certain chemicals and packaging films on the storage-life, chemical changes, and quality of refrigerated fruits and vegetables
Calaproved Seed Company	$225 for insect pollination investigations on legumes

GREENS FOR HOUSES

(Continued from page 5)

REWARDS

A greenhouse unit offers the potential of growing to perfection flowering plants such as Easter lilies, azaleas, gloxinias, or orchids. It may be used to start spring bedding plants like petunias, snapdragons and geraniums, or for forcing Dutch bulbs like crocus, hyacinths, daffodils and tulips. Coordination of temperature requirements and space needs of various plants must be worked out.

The interest is rewarding. Good displays in the greenhouse, or specimens taken inside the home, are a compensation only appreciated by those who have done it.

REPRESENTATIVE HOUSE PLANTS THAT CAN TOLERATE HOME INTERIORS

A. Minimum light (are benefited with intermediate light)	
1. Aglaonema modestum	Chinese Evergreen
2. Aspidistra	Iron Plant
3. Crassula arborescens	Jade Plant
4. Dracaena sanderiana	Dracaena
5. Ficus elastica	Rubber Plant
6. Philodendron cordatum	Heartleaf Philodendron
7. Sansevieria	Bowstring Hemp
8. Schefflera actinophylla	Schefflera
9. Synogonium podophyllum	Nephthytis, or Arrowhead
B. General home conditions	
1. Cissus rhombifolia	Grape Ivy
2. Dieffenbachia picta	Dumb Cane
3. Euphorbia splendens	Crown-of-Thorns
4. Ficus pandurata	Fiddleleaf Fig
5. Hedera helix	English Ivy
6. Monstera deliciosa	Cutleaf Philodendron
7. Pandanus veitchi	Screwpine
8. Pilea cadierei	Aluminum Plant
9. Scindapsus aureus	Pothos
10. Various kinds of cacti	
11. Various kinds of succulents	